The Dock & Harbour Authority

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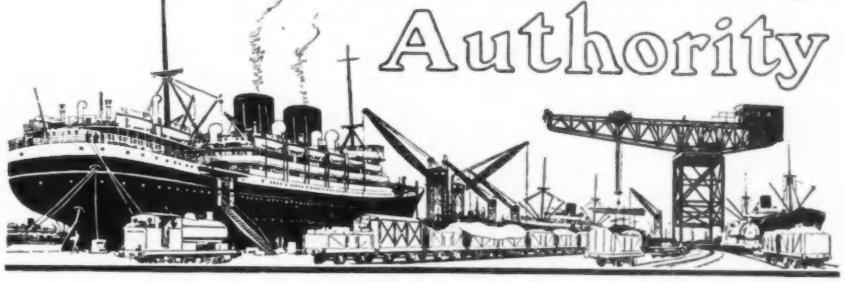

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The Dock & Harbour Authority

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No. 424

Vol. XXXVI.

FEBRUARY, 1956

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Editorial Comments

The Port of Callao

Callao is the principal port of Peru, and indeed the only port in that country which provides complete shelter for vessels alongside in all weathers. The majority of other ports on the coast of Peru and also of Chile have little accommodation, and it has been customary for ships to lie at anchor offshore and to load and discharge by lighters.

Although Callao is situated no more than twelve degrees south of the Equator, the climate is temperate and at times chilly. The sky is more often than not overcast and strong winds are rare. This unusual climatic condition is caused by the peculiar oceanography of the coast of both northern Chile and Peru, where the water inshore is cold. This is caused by the upwelling from the sea bottom of water which is heavily charged with nutrient salts, and in consequence sustains extraordinary quantities of plankton, fish and bird life. Known as the Humboldt or Peru Current, this cold water drifts north and west towards the borders of Ecuador before turning seawards towards the Galapagos Islands. In the days of sailing ships, it was not an uncommon occurrence for vessels to be becalmed within sight of Callao in Peru or of Iquique in Chile, and, being unable to make anchorage, to be carried north by the current. The only way, therefore, in which they could make port was to take a long circuit west and south into the Pacific and to approach the Port again from the south.

Although the Humboldt Current is for the most part predominant, resulting in a rainless climate in coastal Peru, there have been times when a counter current from the north (known as "El Nino," The Child, because it arrives at Christmas) has overlaid the cold water and killed the plankton and fish. At such times heavy rain falls in Peru, and the decomposing marine life evolves gases including hydrogen sulphide which blackens the paintwork of ships. This condition is known as the "Callao Painter." Fortunately it is of rare occurrence, the last severe attack being in 1925, and the one before in 1887.

The Port of Callao was enlarged in 1934, but it was some time before the port organisation was brought into line with the new construction. Our leading article this month deals with the modernised and re-equipped port, which can now be considered to have taken its place among the up to date ports of the world. Owing to Peru's geographical situation, hemmed in by the Andes, an effective port has become in recent years an absolute necessity to enable the country to play its full part in international trade.

New Docks Terminal at Southampton

For many years passengers and cargo between the United Kingdom and South Africa have passed through the wharves and sheds of the Old Dock Estate at Southampton. A welcome change has now taken place with the inauguration of a thoroughly up to date Terminal in the New Docks, which was opened on January 25th.

The New Docks Terminal is situated towards the eastern end of the New Docks Estate, on the site of the sheds of berth No. 102, which were destroyed by enemy action in 1940. The building is 932-ft. long, with a breadth of 121-ft. and a maximum height of 52-ft. The main building has annexed to it on the north side a semi-open gantry crane bay approximately 442-ft. long and 20-ft. wide, while on the south or quayward side is a loading platform 640-ft. long and 34-ft. wide. The eastern end, which is slightly narrower and 196-ft. long, contains a modern passenger terminal with all facilities for the reception and handling of passengers. Above this, at mezzanine level is office accommodation for Customs, Shipping Company's and Dock Authority's staffs.

The new Terminal contrasts with the Ocean Terminal (opened in July 1950 and described in the August 1950 issue of this Journal), in that the passenger reception area is provided on the ground floor, and not on the first floor. Presumably this has been found to be more convenient in the new Terminal, as passengers' luggage does not have to be landed on the quay, and then be conveyed aloft for examination and subsequently returned to ground level for loading into trains or road transport.

Speaking at the opening ceremony, His Excellency, Mr. G. P. Jooste, High Commissioner for South Africa, referred to the considerable and ever growing trade between Great Britain and South Africa, which at present consists of exports from the Union of some £100 millions and imports from the U.K. of some £160 millions per annum. A large proportion of this trade passes through Southampton and the creation of this fine new Terminal is the expression of the expectation of a sustained and increasing commercial relationship in the years to come.

We hope to publish in this Journal in the near future an article giving full details of the new Terminal's construction and equipment.

Concrete and Constructional Engineering.

In this present age, the use of vast quantities of reinforced or prestressed concrete in civil engineering works is so much of a commonplace, that it comes as something of a surprise to be reminded that reinforced concrete was first used in Britain not much more than half a century ago. The phenominal expansion of works in concrete during the past fifty years has been ably chronicled by the journal "Concrete and Constructional Engineering" whose fiftieth anniversary number appeared in January, and to whom we extend our congratulations. Each facet of the development of those engineering techniques, which are the outcome of the Industrial Revolution, has needed and has mostly found an outlet through the press whereby practitioners could keep themselves informed of current development, and could in turn contribute the results of their experience. The world of concrete is no exception in having had for so many years a competent organ. One of the articles in the Jubilee number concerns early concrete maritime structures and, as it will, we think, be of interest to our readers, we have arranged for its reproduction in this issue.

We much regret that, owing to a trade dispute in the printing industry, there has been a delay in publication and it has also been necessary to appreciably curtail the number of pages in this issue. The final instalment of the article on "The Hopper Dredge" is unavoidably deferred until the March issue.

The Port of Callao, Peru

New Construction and Improved Working Methods

(Specially Contributed)

Callao, the principal port of Peru, lies eight miles westward of the capital city of Lima with which it has good road and rail connections. The latter is part of the Andean Highway which crosses the Andes and runs to the river port of Pucallpa on the River Ucayali, one of the largest tributaries of the Amazon.

The first phase in the development of Callao into a modern and well-equipped port was completed by the Frederick Snare Corporation, an American firm, in October 1934. This Company administered and operated the port until it was reimbursed for construction costs, which took until 1 May, 1953. The Peruvian Government then assumed direct administration of the terminal, this function being designated the responsibility of the Administracion Portuaria of the Ministry of Finance and Commerce.

For several years the Port has been confronted with various problems of which port congestion appears to have been the outward manifestation. Several studies had been made of the conditions existing under the Government's management and operation of the port; everybody admitted it was bad but little was done to alleviate the situation.

Finally, on 1 April, 1951, the European Steamship Conference imposed a 25 per cent. Port Congestion Surcharge on all freight carried by member's vessels bound into Callao for discharge at that port.

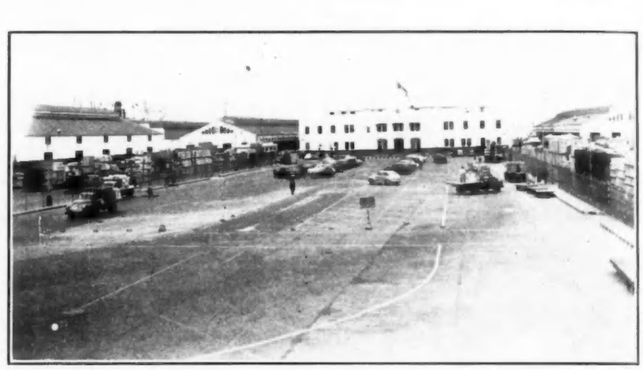
Confronted with a situation calling for remedial measures, the Government adopted the recommendations of an Economic and Financial Mission under the direction of Klien and Saks of Washington D.C., as well as those of Admiral Stanley, an American expert who came to Peru to study the Port problem. Action was taken by :—(a) authorising an expenditure of $1,000,000 for modern cargo-handling equipment for the port ; (b) by deciding to obtain a foreign loan for this purpose and (c) by obtaining the services of Col. Howard W. Quinn, U.S.A. (retired), an expert on organisation, administration and operation of modern ports and an authority on modern cargo handling methods.

Colonel Quinn arrived in Lima in April, 1951, and after a brief survey of the port, found that the difficulties experienced in Callao in the past few years had largely been due to inadequate organisation and could be remedied without the additional expenditure. The reorganisation, which he recommended, together with a modest and self-amortizing investment to modernize cargo handling methods would result in an improved port, capable of rendering an efficient public service and an adequate financial return to the State.

View of back of sheds on Pier 2. Grain Silos in background.

It was then recommended that (a) the Government place immediate orders for materials handling equipment in order to mechanize general cargo handling operations in the port, (b) that a complete reorganization be effected in order to take the port activities out of politics and put the organization on a firm business-like basis and (c) that the handling of bulk grain, the largest single item of cargo in Callao, also be modernised.

The Economic and Financial Mission handled all the technical



The Customs and Administration Building.

details with the World Bank and succeeded in getting a clearance on a $2,500,000 loan.

The Mission was then confronted with the task of drafting the legislation required to eliminate legal barriers to progress, and the appropriate legislation to establish a centralised port administrative agency capable of carrying out the proposed reorganisation and making a profit on its operations, even while amortising the cost of modern equipment through repayment of the loan.

The solution of these two high level problems of financing and legislation involved a third and far reaching problem of particular significance to foreign capital. This was the settlement of Peru's International Debt. Through a series of negotiations, the Peruvian Government and the United States interests represented by the Foreign Bond Holders Protective Council, reached an agreement and the Peruvian Congress passed the necessary laws to enable the agreement to be carried out.

By July 1952 all the high level problems had been resolved, and on July 16th the Board of Directors of the Port of Callao Authority was installed. In its first session, the Board approved and ordered to be executed the Port Modernisation and Mechanisation Programme presented by Col. Quinn, who had been appointed Executive-Director of the Port Authority.

The development plan included :—

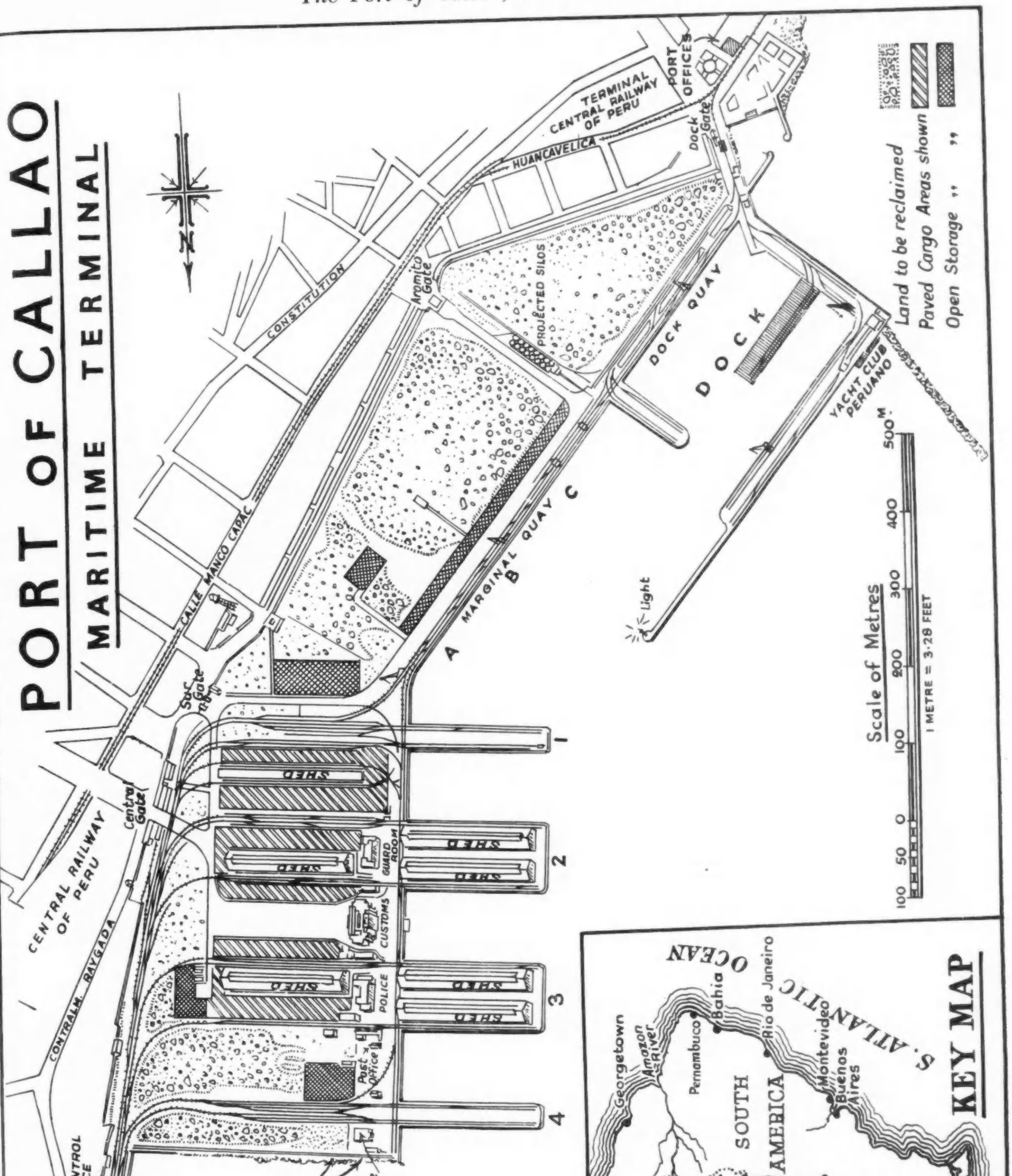
(1) General Cargo Handling Project.
(2) Bulk Grain Handling Project (including dredging of the harbour).
(3) Reorganisation.

(1) General Cargo Handling Project

This included the following :—

1. Purchase of the necessary materials handling equipment to mechanise general cargo handling operations in the port.
2. Purchase of pallets, pallet racks and the purchase and/or fabrication of the necessary stevedoring gear and equipment to enable the port to obtain the most effective use of the new equipment.
3. Purchase of the necessary shop tools and equipment to efficiently maintain the new materials handling machines.

The Port of Callao, Peru—continued



The Port of Callao, Peru—continued

The dry climate of Callao facilitates open air cargo storage.

4. Repair of existing piers, warehouses, buildings, roadways, etc., to correct the deficiencies resulting from long neglect of the port facilities, buildings and structures.
5. Installation of the pallet rack system in pierside warehouses plus other modifications to provide the Port with four modern general cargo berths.
6. Creation of additional open storage space by paving three available areas, and the creation of additional hard-stands by filling and levelling various areas where the costs involved were comparatively small.

2. Bulk Grain Handling Project

This involves the installation of a modern terminal grain elevator with a storage capacity of 20,000 tons of wheat. The facility will be provided with two ship discharge towers with a total capacity of 300 tons per hour. The necessary provisions will be made for discharge to railway wagons and trucks simultaneously and will provide for the automatic weighing of the grain.

In order to accommodate a full ship at the site selected as the bulk grain berth, dredging will be necessary and since the port has been neglected for a number of years, it is planned to dredge the entire harbour.

3. Reorganisation Project

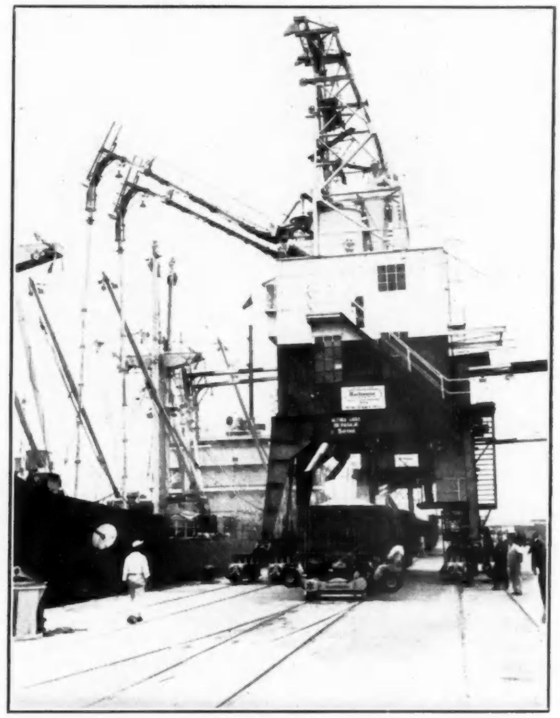
Had it been possible to start from the beginning with an entirely new organisation and a new labour force, the problem of re-organisation would have been greatly simplified. However, as that was not possible the Port Authority had to assume jurisdiction over the old personnel and take over the property involved with a very reduced staff. It also had to carry out its reorganisation programme as opportunity afforded, and with as little interference with the normal port operations as possible. Nevertheless, despite the difficulties encountered, the Port Authority is now organised along functional lines similar to the general type of organisation used by the more successful centralised port administrative agencies in the United States.

Interior of Transit Shed. Pallets being handled by fork-lift trucks.

General Description of the Port

The protected inner harbour consists of a basin a little more than one square mile in area formed by two rock breakwaters, the north breakwater being 7,130 ft. long and the south 3,570 ft. The entrance channel, with a depth of 37 ft. at low water, is 450 ft. wide. The distance between the lights on the channel buoys which are 3,280 ft. out to sea from the breakwaters, is 592 ft. which is also the distance between the lights marking the entrance between breakwaters.

Port facilities consist of a modern marine terminal with berthing space for eleven ocean going vessels and a protected basin for coastwise shipping and small craft. Ample anchorage facilities exist in the outer harbour for ships of any size.



Mobile Grain Discharging Appliance.

Terminal berthing facilities consist of one bulkhead wharf 1,920 ft. long, extending due north from which four piers extend out at right angles, there being two 600 ft. long by 100 ft. wide, and two 600 ft. long by 282 ft. wide. The berths to the south of Pier No. 1 (South Pier) and to the north of No. 4 (North Pier) are each dredged to a width of 126 ft. and have a depth of 32 and 37 ft. respectively at low water ; the berths between Piers Nos. 1 and 2 and between Nos. 3 and 4 are 299 ft. wide with 32 ft. depth ; the centre slip is 306 ft. wide and has a depth of 37 ft. All berths and channels are now being dredged to a depth of 37 ft. at low water.

Piers Nos. 2 and 3 each have two steel and concrete asbestos-roofed warehouses 540 ft. long by 89 ft. wide. There are also two warehouses on land one 500 ft. long by 80 ft. wide and one 202 ft. long by 39 ft. wide. These are shown in the Plan numbered 1 to 7.

A bulkhead wharf 1,350 ft. in length extends south of Pier No. 1.

The coastwise shipping and small craft basin consists of the old mole and dock with a depth of 20 ft. The North, South, East and West walls, with a total quayage of 3,700 ft. are used by commercial shipping. The centre pier which is 493 ft. long by 82 ft. wide, is

The Port of Callao, Peru—continued

used by ships requiring repairs. Fourteen 1½ ton travelling steam cranes on rails are available along these quays.

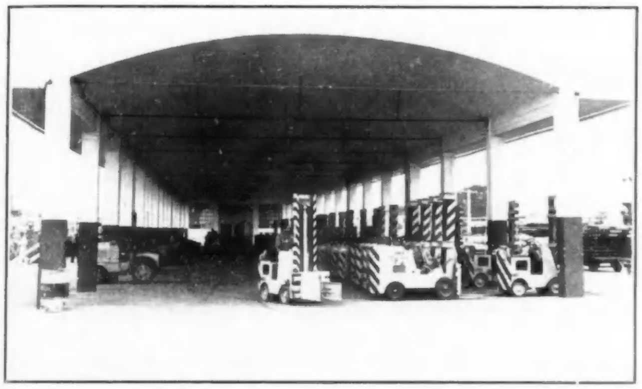
Total open and closed storage space for cargo in the terminal is approximately 1 million sq. ft.

All berths including those pertaining to coastwise shipping are provided with standard gauge double railway tracks.

Pier No. 4 is reserved for the use of tankers that discharge bulk petroleum, kerosene, etc., by means of pipe lines to nearby storage tanks owned by the Government or by private companies. This pier is also used for bunkering operations. During discharge and bunkering operations the necessary fire fighting personnel and modern mobile equipment are provided.

A 50-ton derrick is located at the end of Pier No. 1.

The port is provided with two floating cranes with lifting capacities of 15 and 120 tons respectively. Powerful harbour and ocean-going tugs are available, together with pilots and docking tugs whose services are mandatory for ships entering or leaving the inner harbour Water, bunkers and ships stores are also available and emergency dry dock and repair facilities can be arranged with local Peruvian Naval officials. The port has ship to shore radio communication facilities and a harbour entrance radar station will be in operation in the near future.



Garage for Tractors and Fork-lift Trucks.

All open and closed storage space for cargo is protected by cyclone fencing.

The Terminal has its own fire department consisting of specially trained personnel equipped with the most up-to-date fire fighting equipment. Automatic sprinkler systems are being installed in all cargo warehouses. Discharge or loading of explosives in the inner harbour is prohibited.

Ocean going vessels carrying cargo or passengers, to or from the Port are allowed free entry and exit and the necessary berthing space to load or discharge without the payment of tonnage and wharfage dues, light, pilotage or entry and exit fees or other service charges.

General cargo handling facilities are up-to-date and the terminal is provided with a large well balanced fleet of handling equipment as well as the necessary shops for its maintenance. Included are Fork Lift trucks ranging in capacity from 3,000 to 15,000 lbs., truck cranes with capacities from 1½ to 10 tons with boom lengths of up to 80 ft., and a fleet of modern tractors and trailers capable of carrying palletised cargo loads from 2 to 30 tons.

Construction is now under way to provide a special warehouse for handling valuable cargo liable to pilferage. A special service to ensure rapid and efficient handling of this type of cargo with minimum damage or loss is presently being established.

The terminal grain elevator with a capacity of 20,000 tons of wheat previously referred to is now under construction and scheduled for completion early in 1956.

The south berth on the long wharf will be reserved for bulk grain ships. Two ship discharge towers with a total capacity of 300 tons per hour and capable of discharging directly from tower to truck or railway wagon are now nearing completion at this site. The depth of water alongside this wharf is 26 ft. at low water but dredging operations are now in process to increase the depth to 32 ft.

The reorganisation and introduction of equipment described above have resulted in a substantial improvement in the trade of the port. The following figures supplied by the Peruvian Embassy in London give the total coastwise and deep sea tonnage of cargo handled for the past six years, in metric tonnes.

1949 ...	1,022,545	1952 ...	1,399,520
1950 ...	1,633,268	1953 ...	2,103,177
1951 ...	1,215,380	1954 ...	1,918,387

Projected port works include :—

(1) Construction of a new concrete pier with passenger terminal facilities.

(2) Provision of bulk cargo handling facilities for ore, coal, coke, etc.

(3) Construction of a refrigerated storage warehouse in the port terminal area.

(4) Construction of two additional reinforced concrete warehouses.

The new developments at Callao can not fail to have beneficial effect on the commerce of Peru, for Callao far overshadows all other Peruvian ports, and it handles about 85 per cent. of total Peruvian imports and 25 per cent. of exports, chiefly minerals and cotton.

Although recent developments in road and air have contributed largely towards the solution of the country's internal transport problems, the Peruvian economy, in so far as import and export trade are concerned, continues to be virtually dependent upon ocean transport. The establishment of port working on a firm basis at Callao is thus a vital link in the country's economy.

British Guiana's Ferry Services

Details of Modernisation Scheme

Plans for modernising British Guiana's ferry services include the provision of three 1,000 passenger one-class vessels—one each for the Demarara and Berbice Rivers, with a relief ship on hand. Among other improvements, hinged gantries will enable heavy trucks to be placed on board with speed and efficiency, while unsightly and unsatisfactory canvas weather blinds will be superseded by perspex windows, which will permit passengers a full view in all weathers.

The scheme is completely integrated with the territory's Development Programme and the expenditure $3,500,000 (£729,000) to effect it, has been approved by the Legislature.

The intention is to modernise the British Guiana ferry services thoroughly, starting from the shore end and including the vessels themselves—and to make it possible for the Transport and Harbours Department to accept vehicular traffic as and when it comes along, without advance arrangements.

The existing ferry terminals would be opened up, the old building removed and a two-way approach and departure roadway laid down so that no delay would be occasioned to the circulation of vehicles. There would also be up-to-date assembly arrangements for passengers, with improved seating and general accommodation for them.

The three vessels to be built will be of two-deck design—the lower deck for vehicles, with a capacity of approximately 25 motor cars or 15 heavy trucks or buses, provided with a turntable so that vehicles could be positioned for early discharge from the ship. The upper deck, would be exclusively for passengers and would provide seating accommodation for 700 persons, but with a total capacity for about 1,000 persons at busy periods.

As the country's economy advances, the new ferries should be able to deal with any increase in population and traffic and it should also be possible to expand the operation of the ferries. The third ship would, at the beginning, serve only as a relief ship but it might, at some future date, help to carry out extended services. Later, two more ships may be ordered to speed up the services.

The consulting engineers were Messrs. Coode and Partners, London, who prepared the scheme on behalf of the Crown Agents for the Colonies.

Hydraulic Research in India

Port and Harbour Model Investigations in Progress at Poona

The Central Water and Power Research Station had its modest beginning as far back as 1916. In the earliest stages the Station was mainly occupied with the problems connected with irrigation, land drainage and reclamation, river training, and safeguarding of railway bridges, barrages and weirs from outflanking etc. The Station was re-organised in 1947 and new branches were added. These included navigation, soils and chemistry, concrete and materials of construction, statistics, physics, mathematics and hydraulic machinery. Under this scheme, the Station was attached to the Central Water and Power Commission, New Delhi, and is now working as a wing of that organisation. Some of the problems which are under investigation will be described, from which an idea of the work done at the Station can be obtained.

Calcutta Port Models.

Calcutta is the most important port on the east coast of India, handling annually about 8 million tons of cargo. It is an inland port situated on the banks of the Hooghly River, 90 miles away from the open sea, and as such enjoys all the advantages of an inland port. It has its disadvantages too, which mainly consist of maintaining adequate depths in the 90 miles approach channel, which has a large number of bars and shallow crossings. At present, the Port Authorities spend as much as 50 lakhs annually in dredging these bars. Partly due to the modern trend of ship designs, it has become increasingly difficult for the Port Commissioners to meet increased demands of depths for navigation. The Calcutta Port Commissioners have consulted a number of experts for suggesting various measures for improving the navigability of the river.

This problem has been entrusted to the Research Station. For this purpose, two mobile bed models have been constructed at the Station, one to a scale of 1/2,000 : 1/160, called the estuary model, and the other to a scale of 1/300 : 1/60, called the port model. The former extends from 25 miles downstream of Saugor Island to Bansbaria at the upper end, and the latter incorporates the reach between Konnagar and Moyapur crossing. The improvement of the following reaches is studied in the former, (a) Moyapur and Royapur reaches, (b) Fulta, James and Mary reach, (c) Balari Bar, (d) Outer bar. In the latter the following reaches are studied: (a) Silting near the entrance of King George Dock and Garden Reach Jetties, (b) Sankrail Reach, (c) Hastings Bar, (d) Cossipore Reach.

Models have been proved in respect of tidal characteristics, bore tide, flow conditions and simulation of bed changes etc. The number of spring tides required for reproducing seasonal bed changes has been worked out by trial and error.

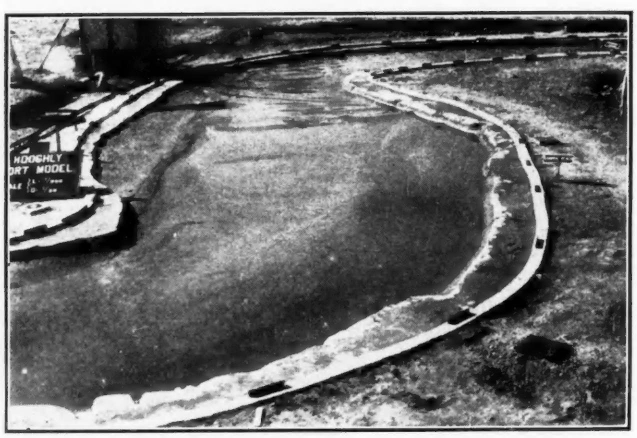


Fig. 1. Sankrail Reach in Hooghly Port Model. The groyne recommended for improving this reach is seen in the background. The bore advancing upstream is also seen.

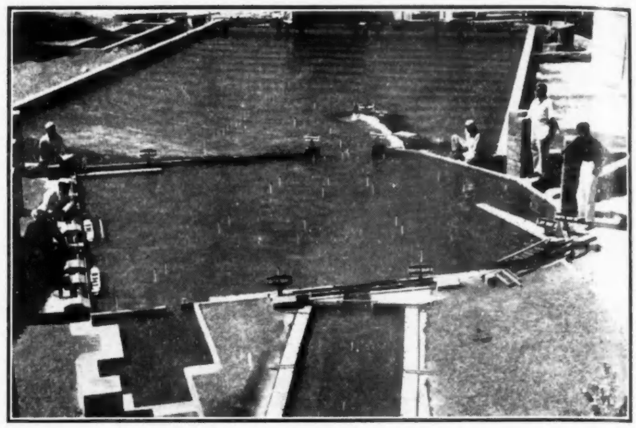


Fig. 2. Madras Harbour. 1/125 geometrically-similar model and storm waves from North East direction.

As a large number of bars and crossings have to be negotiated in the reach between Calcutta and Diamond Harbour, one of the suggestions was to construct a ship canal joining these two places, which would obviate navigation in this difficult reach. If the scheme were to materialise, the Port Commissioners would not dredge the bars in this reach. The effect of this suggestion on the river regime was tested in the model. It was seen that this scheme would result in deterioration of the river from the upper end which would work downstream and would ultimately worsen the conditions in the estuary also. To meet the requirements of navigation therefore, the best way is to improve the river by suitable training measures.

The Fulta, James and Mary Reach has been studied in the estuary model. In this reach there are two bars which increase alternatively so that a close watch has to be kept on the river and the bars have to be dredged continuously. This work accounts for as much as 20 per cent. of the total cost of dredging. A number of experts have suggested various training measures. All these were tested in the model, but none of them showed promising results. The model showed that the only cheap and permanent remedy would be a recession of Fulta Point by 1,200-ft. with reclamations above and below Damodar outfall. The effect of this remedy on other reaches was also studied and it was observed that this would not affect the conditions in other reaches of the river. The proposal is under consideration by the Port Commissioners. Investigations for improving conditions in other reaches are in progress.

Another reach which has been studied is the Sankrail Reach. The trouble in this reach is the divergence of flood and ebb axes during the dry season. Sufficient depths are maintained along the navigation channel during the freshets when the ebb predominates and it develops a cul-de-sac channel along the left bank. In order to improve this reach, a groyne 1,200-ft. long has been recommended after carrying out exhaustive model tests (Fig. 1). The groyne has been constructed this year at the site and it is expected that within 3 or 4 years it will achieve the desired purpose, namely to reduce the divergence of the axes and maintain sufficient depths for navigation even during the dry season.

Madras Harbour Model.

Madras Harbour, on the east coast of India, suffers from ranging action due to cyclonic storms, which originate in the Bay of Bengal in October and November and sometimes early in December. Such a disturbance in the harbour is very troublesome to shipping, at times causing breakages of mooring ropes and damage to berthed ships. Model experiments are in progress at the Research Station to evolve suitable measures to minimise and if possible eliminate this trouble. A geometrically similar model (scale 1 : 125) has been constructed for this purpose (Fig. 2). The analysis of the prototype data, as well as the model experiments carried out in connection with this problem, have shown that short as well as long period waves are responsible for the ranging action in the harbour basin. Various alternatives were tested in the model.

Hydraulic Research in India—continued

The first proposal, which was tested for short period waves, was that of the extension of the present shelter arm. Apart from being expensive, this proposal would have compelled ships to approach the harbour at an acute angle and in shallow water. An attempt at reducing the entrance width was no more satisfactory.

Another proposal which was tested for short period waves was that of spending beaches along the east and south quays. These were found effective in reducing trouble along the west and north quays. The adoption of spending beaches however, called for jetty construction on piles. This construction was likely to be difficult due to the presence of boulders at 30 to 40-ft. below sea level along the south quay, and accordingly this proposal also had to be abandoned.

A modification which showed promise for long period waves, was a wall, 1,200-ft. long, from the east quay, which would break the geometry of the harbour. The harbour basin however, is very small, and this proposal would have impaired the manœuvrability of ships.

Models of projected oil and wet docks have also been tested. Experiments showed that vertical instead of sloping sides for the wet dock would greatly reduce transverse movement of berthed ships and would not be affected by storms. The length of wet dock in the first stage is 1,450-ft. It did not resonate to the long period seiche in the harbour (58-74 seconds), and it responded to a very small extent to short period waves. The length of wet dock in the second stage is 2,900-ft. This appeared to resonate for these periods. Experiments showed this can be prevented by throttling the width from 500-ft. to 200-ft. at the centre of the wet dock.

Mangalore Port Model.

Mangalore is at present a very small port on the west coast of India. Ships lie at anchor about 1½ miles offshore and cargo is handled by lighters because of a bar at the entrance limiting the depth to 8-ft. Here two rivers join the sea through the gut, the Gurpur and the Netravati, having a maximum discharge of 60,000 and 240,000 cusecs respectively. Both rivers are tidal. The Gurpur runs parallel to the coast for 4 miles inside a sand spit before joining the sea. The development of this port to provide a 30-ft. channel is under consideration by the Government of India, and the following three proposals are being investigated in the model.

(i) A dredged channel seaward using the combined scouring force of the Gurpur and Netravati Rivers, with an inner harbour on one of the rivers.

(ii) A dredged channel through the sand spit, diversion of the Netravati and utilisation of the scouring force of the Gurpur.

(iii) A dredged channel seaward and diversion of both rivers.

All the proposals mentioned above are to be tested with and without breakwaters. The model experiments are in progress and proposal (i) has so far been tested in all respects. It was shown that breakwaters would be necessary and even then it would not be possible to maintain a 30-ft. deep channel without incurring heavy dredging costs. A 22-ft. channel is feasible with minimum dredging. The other proposals are under consideration.

Kandla Port Models.

Kandla Port (in the Gulf of Kutch) is being developed as a major port on the west coast of India. The port is being located on Kandla Creek at the head of the Gulf of Kutch. The creek has depths of 30 to 55-ft. below low water and a width varying from 2,000 to 3,000-ft. The spring and neap tides ranges in the creek are 23-ft. 6-in. and 17-ft. respectively. The spring tide spills over a vast area. To facilitate the construction of the Port, a defence dyke has been constructed along the bank to isolate the port area. When the quays are constructed, the bank will also be set back one hundred feet. The bank is being eroded in places and the dyke is in danger of being washed away. Temporary measures in the shape of permeable groynes constructed by driving R.C. C. piles with timber frames between, have been recommended to give temporary protection to the dyke. The effect of widening of the creek is being studied by model tests. Upstream and downstream bank connections are also being designed in the model.

Another problem is at the entrance of the creek, where there is a bar having a depth of 12-ft. at low water. On account of the tidal range, ships can cross the bar for two hours each side of high water, even at neaps. As the port grows, however, it will be necessary to increase the hours of availability either by dredging the entrance channel, or by training works, or by both. A model has been built at the Research Station to study this problem.

Cochin Coast Erosion Model.

About 10 miles length of coastline, south of Cochin Harbour, is under severe erosion. During south-west monsoon, the coast is eroded about 35-ft. every year. After the monsoon however, there is generally an accretion of about 20-ft. The nett erosion is thus about 15-ft. per year. According to local information erosion of the coastline has been going on for at least 100 years. About 5 miles of coast were formerly protected by sea-walls of light construction which were built from time to time. These walls, however, have been completely destroyed in recent years. It appears that the reason for their collapse was firstly, that the walls were made with light boulders of not more than 200 lbs. weight. The pitch was excessive, at 45 degrees, while the walls were not high enough to prevent overtopping. Further, the walls were not built on fascine mattresses, nor were they properly maintained.

A geometrically similar model has been built with a view to evolving an effective sea defence layout.

From the above review it will be seen that there are a number of harbour and coastal problems in India which are being actively studied at the Poona Research Station.

Reconstruction of Gallions Entrance Lock, Royal Docks, Port of London

The following is an abstract of a paper by J. A. Fisher, M.I.C.E., which was read at a meeting of the Institution of Civil Engineers on January 3rd 1956.

The Gallions Lower Entrance Lock was built by the engineering department of the London and St. Katharine's Dock Company with direct labour, and based on the design of the Upper Entrance Lock by Sir Alexander Rendel. It was opened on the 20th July, 1886.

The barrel of the lock has a curved invert to a radius of 110-ft. The principle work of the reconstruction consisted in the removal of the haunches of this invert and the substitution of reinforced knees. The opportunity was taken to recondition the walls and granite work and to provide new gates and machinery.

To enable the base of the lock to be excavated and new reinforced sections inserted, a ground-water lowering system was provided, and the invert of the lock was loaded with concrete kentledge. The inner dam was of blockwork and built under water by divers; the outer dam was of steel-sheet piling and filled with rubble.

All the granite work has been replaced, much of the original material being re-used. The brick facing of the walls was removed and, apart from the gate recesses, the lock was refaced with concrete throughout. Emergency cills were provided at the inner and outer gates. The three original culverts in the floor of the lock were removed and reconstructed to larger dimensions. This entailed the diversion of high-pressure sewerage pipes, together with gas, water, and other services.

The original gates have been replaced with buoyant gates, and the gate-operating machinery is of a double-geared balanced type driven through fluid couplings from an electric motor. The sluice machinery has been rebuilt with the original rams reconditioned for use with oil. The outer sluiceways were found to have been the cause of a large scour on the outer apron. By means of a tidal model this scour was investigated and the sluiceways modified.

The jetties have been reconstructed and the opportunity taken to build one section of a flexible steel type. This work is not yet completed.

It is expected that the whole of the reconstruction work when completed will have taken approximately 5 years, and the total cost will exceed one million pounds.

[A further contribution on the subject by G. L. Spear, A.M.I.C.E., will shortly be published in this Journal.]

Stabilisation of the Mississippi

New Orleans in Jeopardy

Introduction

The port of New Orleans, the largest city and port in Louisiana is situated on the banks of North America's greatest river, the Mississippi. It would perhaps be more correct to say that the city is situated under the bank of the river, since much of the Old Town is below river level, and inundation is prevented only by the existence of huge levees which contain the flood waters. In this sense the city might seem to be precariously placed, were it not for the confidence which has justifiably been placed in the elaborate flood control measures which have been built up during the past quarter century by the Federal Government acting through the U.S. Corps of Engineers.

Anyone who contemplates the massive flow of the Mississippi at New Orleans would have difficulty in imagining that the river had not flowed past that spot from time immemorial, and would continue to do so. Such however is far from being the case. Not only has the river not always flowed in its present channel, but, saving remedial measures, it will shortly remove itself into a new channel.

A Wandering River

The history of the lower Mississippi Valley in recent geological time is interesting in that it shows what has happened in the past, and what can happen in the future, if there is no human intervention. The lower alluvial valley of the Mississippi is a relatively flat land formed by deposits and meanders of the river. The valley walls are at places 80 miles apart. Within these the Mississippi has ranged for thousands of years, altering its course from time to time. In addition to the main river there have always been subsidiary drainage channels to the sea, and these, as will be seen, are important to the development of our theme.

The earliest of the Mississippi courses of concern to this discussion is that of the Teche-Mississippi which closely followed the western wall of the valley and entered the sea near where Morgan City is now (Fig. 1). About 900 A.D. the Teche course was abandoned in favour of the Lafourche-Mississippi course adjacent to the eastern valley wall. The river occupied much of its present channel but below Baton Rouge it took the Lafourche course Route to the sea some distance west of New Orleans. The Lafourche course was abandoned in about 1200 A.D. and the river adopted its present course, on which the City of New Orleans was founded. One primary characteristic of a river flowing through flat lands is for it to meander, so that its course is lengthened, and the gradient flow reduced. Another is that the river gradually raises its banks and finally its whole mass above the level of the surrounding country.

Studies of the former Mississippi diversions has shown that in each case the new course taken by the river was through the route of a smaller stream flowing in a lowland nearby. The smaller stream became a distributary of the main river when a migrating meander loop intersected it. Following this the distributary enlarged until it became the new Mississippi course, and in doing so it passed through distinct development stages.

Increasing Importance of the Atchafalaya River.

The most recent of these distributaries is the Atchafalaya River, which has become connected indirectly with the Mississippi through a meander loop of a tributary of the latter, the Red River (Fig. 1). The part of the Red River between this loop and the Mississippi is called the Old River. In times of flood the Old River is reversed, and flood water from the Mississippi discharges up it to the Atchafalaya River. The latter flows at present through a lowland similar in many respects to those followed by former main river diversions. Its course is relatively straight, and its length from the Old River to the sea is less than half that of the Mississippi by way of Baton Rouge and New Orleans. The gradient is therefore much greater, and consequently water tends to flow down the Atchafalaya in preference to the Mississippi.

It has been determined, as a result of studies organised by the Mississippi River Commission that when a distributary of the main river carries approximately 40 per cent. of the major river's flow,

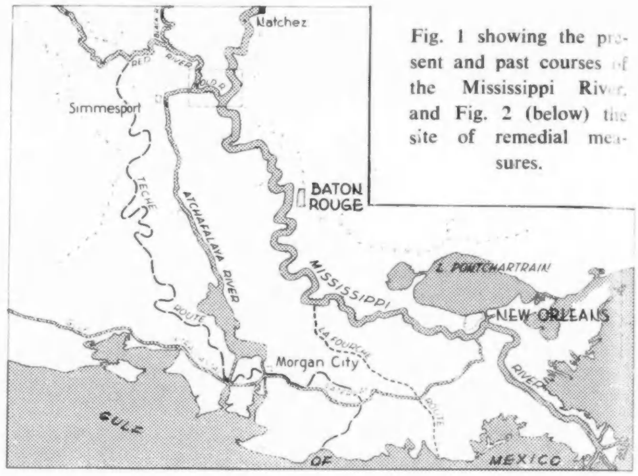


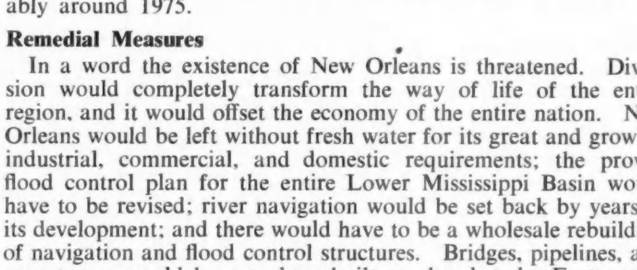
Fig. 1 showing the present and past courses of the Mississippi River, and Fig. 2 (below) the site of remedial measures.

a critical stage has been reached. After this, diversionary activity is greatly accelerated as the new channel develops rapidly in an attempt to reach equilibrium. At the same time the major river channel deteriorates, commencing when the distributary flow reaches 20 per cent., and accelerating when the flow reaches 30 per cent.

Further studies on the development of a new and stabilised river channel in the Atchafalaya River (without which the main flow of the Mississippi would not choose a new route to the Gulf) have indicated that an efficient single river channel would at the present rate of change become established by 1985-90. But that is not all; the increasing diversion of Mississippi water into the Atchafalaya would result in a general deterioration of the main river between its leveed banks, which in turn would accelerate the rate of discharge down the new distributary. Weighing up the various tendencies the conclusion has been reached that the Atchafalaya River could well become the main or master stream below the Old River somewhere between 1968 and 1985 and probably around 1975.

Remedial Measures

In a word the existence of New Orleans is threatened. Diversion would completely transform the way of life of the entire region, and it would offset the economy of the entire nation. New Orleans would be left without fresh water for its great and growing industrial, commercial, and domestic requirements; the proven flood control plan for the entire Lower Mississippi Basin would have to be revised; river navigation would be set back by years in its development; and there would have to be a wholesale rebuilding of navigation and flood control structures. Bridges, pipelines, and even towns would have to be rebuilt or abandoned. Fortunately however the problem has been appreciated in good time, and remedial measures are already under way. In planning these cognisance had to be taken of the existing and proven flood control plan which was authorised in 1928. The total flood control con-



Stabilisation of the Mississippi—continued

cept is complex and need not be described here in detail. The feature which is relevant is that the Atchafalaya is already rendering useful service, and its continuance as an overflow channel is essential to the wellbeing of the Lower Mississippi Valley. The essence of the new works therefore is to regulate the flow of the Mississippi and its tributaries in such a way that the Atchafalaya does not get out of control, and eventually rob the main channel, while at the same time maintaining a flow in the Atchafalaya sufficient to keep the channel open at all times for the disposal of flood water.

Fig. 3. The Atchafalaya Basin. Convergence of Red and Old Rivers on left. Mississippi at top right.

This is a very large undertaking indeed, and the cost is estimated at about 47 million dollars excluding a navigation lock.

The proposed works are located in the region where the Mississippi, the Red and Old Rivers converge (see Fig. 2). The area enclosed by these rivers is also shown in Fig. 3 from which it will be seen that the enclosure is a huge swamp called the Atchafalaya Basin.

The first of the structures to be built is called the "low-sill" structure. This will be built on the west bank of the Mississippi about ten miles north of the Old River. It will control flows at all stages from the Mississippi through a dredged outflow channel into Red River for passage into the Atchafalaya.

The second unit will be the "overbank" structure, located just upstream from the "low-sill" structure. This will be two-thirds of a mile long, and will be used during time of flood to pass excess floodwaters out of the Mississippi into the Atchafalaya Basin.

Just southwest of the Old River-Mississippi junction a navigation lock is to be built. It will be joined by land cuts to the two rivers so that the rapidly growing barge traffic can move without interruption over the river systems. Levees on the Mississippi river to the north and south of the controls structure will be raised and strengthened.

The final work will be the sealing of the Old River by a closure dam, in order that uncontrolled flow from the Mississippi may be permanently stopped.

The work will take ten years and will be carried out by the New Orleans District under the supervision of the President, Mississippi River Commission, Corps of Engineers, U.S. Army. It is interesting to note that the commencement of this work has literally given the Port of New Orleans a new lease of life, and that a 60 million dollar port building and improvement programme has been launched in consequence.

Material and illustrations for this article were kindly provided by the Port of New Orleans and the U.S. Army Corps of Engineers.

Breakwater for Porto Grande

It is reported that the Portuguese Government has placed a contract with Construcoes Tecnicas, Ltda., Lisbon, for the construction of a breakwater at Porto Grande, St. Vincent. The breakwater will project out from Pontinha and will be 1,000 metres long. About ten vessels are expected to be accommodated at the same time for oil bunkering, etc.

Cross-Channel Passenger Movement

Shore Arrangements and Ship Design

A paper entitled "Passenger Comfort in the Short Sea Trades" by Mr. J. L. Harrington, Chief Officer (Marine and Administration), British Transport Commission, was presented to a meeting held in London last month by the Metropolitan Section of the Institute of Transport. The following excerpts are taken from Mr. Harrington's address.

An outstanding feature of post-war travel has been the growth of passenger movement across the narrow seas to and from Great Britain. A large share of this traffic has been conveyed by air, but it is noteworthy that the numbers by the surface routes have been sustained and augmented.

Apart from speed, air has other advantages which must not be discounted. The numbers handled per unit are smaller, and this facilitates the customs and passport controls, where these are necessary. Moreover, these controls are carried out in modern airport buildings, which have been provided by governments—along with the airways' control systems—by the expenditure of vast sums of a capital nature, the charges in respect of which are by no means fully borne by the operating companies or the passengers.

Thus, in discussing comfort in the short sea trades, it is impossible to divorce the ship from the shore. The basic design of many of our packet ports dates from a time when there was free trade and free movement of passengers, whereas today customs' examinations are involved on the continental, Channel Islands and Irish Republic routes, and passport control is also applied to continental journeys. It is encouraging to know that, in the scheme for the modernisation of British Railways, £12 million has been allocated for the packet ports, and planning is actively in hand.

Train Ferry Services

A train ferry service eliminates the transfer at the ports. The overnight journey without change from the centre of London to the centre of Paris—with customs and passport controls at the terminals—is, undoubtedly, the most convenient route between the two cities.

Through services by train ferry are a feature of transport in the Baltic and have been developed to a far greater extent there than elsewhere in Europe. But, the Baltic is a relatively calm and almost tideless sea. There are large tidal ranges around the British Isles and some of the packet ports have virtually only open sea berths: in consequence, the inception of train ferry services—especially for passenger vehicles—involves the installation of expensive terminals.

Train ferry vessels must be employed on routes where they can be fully utilised by taking advantage of quick turnrounds in port and offer by these means facilities not only for passenger coaches but for freight wagons and possibly road vehicles. The passenger trade by itself can only perhaps be justified in relation to the rail earnings on both sides of the channel.

Shore Arrangements and Modernisation Plans

What kind of service should the transport administrations aim to provide? The passenger may reasonably expect fast and comfortable trains from and to the ports, with refreshments and sleeping facilities, as appropriate. In this country, the forthcoming extensions of electrification to Folkestone, Dover and Harwich should enable improved standards of service to be offered as will also the introduction of diesel traction on the lines to other packet ports. With the growth of international travel—and its appeal to all sections of the population—the British Transport Commission may feel there is a demand in Great Britain for more cross-country services direct to the ports, which could conceivably be met by express diesel rail-car sets.

The facilities for passengers arriving or departing by road must not be overlooked. Although there is now splendid shore accommodation for the passengers in private cars or motor coaches by the special Dover/Boulogne vehicular ferry, those arriving or departing by road in connexion with the ordinary cross-channel services are not so well placed—road access to the quayside buildings was not an important feature when the railway packet ports were first developed.

Cross-Channel Passenger Movement—*continued*

British Railways, in implementing the modernisation plan, will doubtless be guided by the following principles :—

(1) nowhere, during the transfer from the land vehicle to the ship should he be exposed to the weather ;
(2) the layout of buildings, and the access thereto, should be such as to minimise congestion ;
(3) on arrival by ship, passengers should not be held for an unduly long time aboard while those first off the ship filter through the controls ;
(4) location of hand baggage at various stages in novel surroundings should be as simple as possible.

There is no ready-made solution—the various routes all have their own particular types of traffic and port features. In planning for the future, they must each be studied in relation to up-to-date concepts of passenger handling and to the use of modern equipment and new materials : co-operation between all the authorities concerned is essential.

But, it must never be overlooked that the geographical position of packet ports has been determined by the need to achieve the most favourable co-ordination of land and sea services. In almost all places space is limited. The examination halls, the primary purpose of which is the exclusion of undesirable aliens and the collection or protection of the revenue of the realm, have somewhat curiously to be provided by the port authority and thus directly—or, indirectly, by the payment of dues—by the shipowner.

The Cross -Channel Ship

In turning to the ship it is well briefly to define the tasks confronting the naval architect in designing a cross-channel passenger vessel, viz. :—

(1) she must be of such a size that she can enter and leave the packet ports at almost all states of the tide. In particular, this limits her draft, the least being 11 ft. on the Newhaven/Dieppe service and the most 15 ft. on the Harwich Hook route ;
(2) she must have powerful machinery, not only to maintain the schedule passage times but to manoeuvre in port or in the approaches thereto : good manoeuvrability without the use of tugs, which are time wasting and expensive—is essential for cross-channel ships ;
(3) she must be able to put to sea in almost any weather : she must be so sub-divided as to retain stability in certain damaged conditions and the construction of the ship must be such as to confine an outbreak of fire within a limited space ;
(4) she must serve as a temporary home for the 60 or 70 members of her crew, whose accommodation must at least conform to the statutory regulations in regard to space, amenities and position.
(5) subject to the foregoing, she must provide accommodation for the passengers, their baggage and such cargo as it is desired to convey.

Passenger accommodation has to be related to the requirements of the route on which the vessels are normally engaged. There is, of course, a constant urge to improve the standards and the space allocated. Since, as previously mentioned, length and draft are restricted and better provision has to be made for crews, the tendency has been for a higher superstructure. This results in increased windage, which must be counteracted by better manoeuvrability.

Difficulties occur when provision has to be made to carry at peak periods passengers over and above those that can be carried in private cabins. The same kind of problem arises in designing a vessel which is required to take both day and night passages. It is necessary in such vessels to attempt to include spacious public rooms and a number of private sleeping cabins. The design must obviously be a compromise and suffers from the defects thereof.

Ships of the Future

It may be appropriate to say something in general about ships of the future in relation to the cross-channel services. Shipbuilding and marine engineering, although relatively old industries, are at present buoyant with new ideas, but not all of these could, with advantage, be applied to passenger vessels in the short sea trades. It has to be realised that the cross-channel services have specialised characteristics : the ships have to be built to suit the geo-physical limitations of the packet ports and the number of hours' steaming each year—having particular regard to the seasonal nature of much of the traffic—is small in comparison with that of a deep sea vessel. Further, the design must fit in with the traffic organisation of a closely integrated land and sea operation and, to achieve a better and more comfortable service for the passenger, there may be need in the future to stress this aspect even more than in the past.

In larger passenger vessels, one development—but not at the moment a general tendency—has been the positioning of the machinery aft instead of amidships. The advantage to the passenger in such an arrangement is that the best part of the vessel—amidships—can be devoted solely to accommodation, instead of being given over largely to the machinery.

A cross-channel vessel designed in accordance with such a conception presents a difficult problem, taking into account the size of the ship and her shallower draft : considerations relating to the type of machinery, the hull form and the disposition of weights are all involved. It is unlikely that the types of machinery at present available could be installed right aft in a cross-channel passenger vessel.

But newer and lighter forms of machinery—such as a suitable gas turbine—are in sight, and it may be that the British Transport Commission, in their studies, are thinking along the lines of introducing, in the years ahead, vessels of such design. It is certain that the location of more passenger accommodation amidships would greatly add to the comfort of cross-channel travellers. Moreover, the greater freedom so given to the architect in the layout and positioning of the public rooms, entrance foyers and stairways would increase the attractiveness and convenience of the vessels. But, such a dispotiion of the machinery would involve all the baggage mails and, where carried, cargo being loaded in a forward hold : this may, in turn, call for a reorganisation of methods of working ashore and an alteration of quayside facilities.

Increased Lighterage Facilities for Famagusta, Cyprus

Work began in December on a £19,000 project designed to increase lighterage facilities at Famagusta, where some 50,000 freight tons are loaded and unloaded monthly.

When completed the new project will provide a small lighterage basin south of the Schooner Jetty capable of accommodating a larger number of lighterage craft than are now in use. The basin will be formed by building a jetty, 120-ft. long by 30-ft. wide, parallel to the Schooner Jetty, and by constructing a 120-ft. quay between the jetties. The project is intended only as a temporary measure until extensive port development, as envisaged under the Milbourn Report can be undertaken.

As a result of the Milbourn Report, representatives of the firm of engineering consultants, Coode and Partners, London, have been surveying Cyprus ports for the past few months, and a report of their findings is awaited. Meanwhile, the big lighterage basin at Limassol, already partly working, will be in full operation by the end of this month. When working to full capacity it will, together with the loading jetties, permit the handling of upwards of 35,000 freight tons monthly.

Montevideo Port Improvements

A report issued by the British Chamber of Commerce in Uruguay states that one of two land reclamation schemes the Government has decided to submit to the International Bank of Reconstruction and Development is for reclaiming 830 hectares in the Bay of Montevideo at a cost estimated at 85 million pesos. There is an additional project in conjunction with the reclamation scheme to improve port facilities by constructing a dry dock, a new pier equipped to handle grain, fertilisers and coal, and a new discharging basin suitable for shallow draught river craft which would free the existing deep-water berths for ocean-going ships.

New Members for I.C.H.C.A.

The International Cargo Handling Co-Ordination Association announce that, during the past months, new members have included the National Harbours Board of Canada, the ports of Chittagong, Alicante, Valencia and Santa Cruz (Teneriffe), together with the Spanish State Railways and shipowning and stevedoring concerns in a number of other countries.

Early Concrete Marine Structures

By F. E. Wentworth-Shields, O.B.E.,
Past President of the Institution of Civil Engineers.*

The branch of engineering that involves the use of concrete has seen some remarkable changes since the beginning of the century. Fifty years ago, although we were congratulating ourselves that Portland cement was evidently going to be very useful to the engineer, we little thought that its uses would soon become so diverse and so complicated that, in order to master them, a qualified engineer would find it worth while to devote a year of post-graduate study to this subject under the tuition of a specialist. That is what is happening today. At the beginning of this century the writer had the good fortune to be engaged as a young engineer at the Port of Southampton which, from small beginnings, was growing to be a famous gateway of England, and which was one of the first ports to adopt what was then regarded as a weird novelty, namely, reinforced concrete. The first maritime structure in reinforced concrete in this country was erected at Southampton in 1899, and is still giving good service.

At that time, and during the previous fifty years, an enormous amount of railway and dock construction had been carried out, in this and other countries, in which concrete was freely used. Most of the plain concrete retaining walls we see today belong to this period. Almost all were highly successful. A very few failures occurred, generally due to chemical action of sea-water or sulphate water on "unsound" cement. The chemistry of Portland cement was not so well understood as it is now, and occasionally a consignment was received containing uncombined lime. The effect of sea-water or sulphate water on concrete made with such a cement was to cause it to swell and disintegrate. This trouble might occur months after the concrete had set, especially if the concrete were ill proportioned and consequently permeable. The engineer using concrete for maritime works was therefore constantly on the watch for unsound cement. Before Le Chatelier produced his test for soundness, engineers used to make pats of neat cement, about 3 in. diameter and about ½ in. thick at the centre and diminishing to a feather-edge; these were immersed in cold water and, if the cement contained an excess of uncombined lime, the edges would crack. Moreover on important works, as an additional precaution, the cement was stored on a dry floor and turned over by men with shovels three times at weekly intervals. The introduction of the rotary kiln and of finer grinding, and the careful chemical control introduced by the manufacturers about this time, did away with the necessity of this process—to our great relief.

The rotary kiln was an immense boon both to the manufacturer and to the user of Portland cement, as it not only reduced costs but also ensured the cement being calcined at an even temperature and thus abolished troubles from underburnt and overburnt cement. At first, however, some rotary kilns yielded a cement which was "flash" setting. Such a cement would appear to set in a matter of seconds instead of minutes and, if re-wetted and laced in position, the setting-time became alarmingly slow. This trouble was soon conquered by controlling the quantity of added gypsum.

It may be said, therefore, that when reinforced concrete began to be used in this country the manufacturers were able to supply a good and reliable cement, and that this has contributed largely to the success of this new material. In the early days, however, there was a good deal of prejudice to overcome. Engineers who had used concrete in massive breakwaters and retaining walls had great confidence in it, but they were nervous of using it in comparatively thin sections containing steel bars with a cover of only an inch or so of concrete to prevent the steel from rusting; indeed some of the early experience with the new material showed that their fears were not altogether groundless.

The first of the maritime structures built in reinforced concrete at Southampton was a jetty consisting of a reinforced concrete deck measuring about 100 ft. by 40 ft. on piles of the same material. It was erected in 1899 at a shipyard which in 1906 was acquired by Messrs. John I. Thornycroft & Co., Ltd., the famous builders of naval destroyers, and has been in constant use throughout its long life. It was designed and supervised by Hennebique of Paris. Its equipment includes a crane with a capacity of 60 tons, which is used to lift boilers and other heavy loads on to ships lying alongside. The foundation of the crane is independent of the jetty, but it will be readily understood that its use causes much hard wear on the jetty. In spite of this the writer found on a recent visit that the structure was in excellent condition and showed no sign of deterioration.

A few years later (1902) Town Quay was built at Southampton Docks by the Railway Company which then owned them. This, too, was a reinforced concrete structure measuring 360 ft. by 20 ft., and about 34 ft. high. It was equipped with travelling grab-cranes which transferred coal from South Wales colliers alongside the jetty to barges on the other side. The barges were subsequently towed to ocean-going steamers, where the coal was transferred to their bunkers. The jetty consisted of a reinforced concrete deck carrying the cranes and resting on piles of the same material, stiffened with longitudinal, transverse, and diagonal bracing. In a very few years this jetty, though apparently well built, showed signs of serious decay. The piles and bracing below mean tide-level were quite good; but above that level longitudinal cracks appeared in the piles, braces, and deck-beams. These cracks followed the lines of the main reinforcement bars and were obviously due to the steel rusting under the concrete cover and bursting it off. The deterioration became so serious that the jetty was pronounced unfit to bear the weight of the cranes, and it was strengthened with new piles and decking.

Other reinforced concrete jetties at Southampton in the early years of this century suffered similar deterioration though, fortunately, not to the same extent. Mr. J. P. M. Pannell, Engineer of the Harbour Board, gave a most interesting paper* at the Institution of Civil Engineers describing how such deterioration was arrested at the Southampton Town Quay by means of gunite. This work has been very successful. The writer was given an opportunity of seeing it recently and found that, although the gunite is now nearly twenty years old, it is in excellent condition. Readers of Mr. Pannell's paper will realize, however, that the success of gunite involves great care and skill in carrying out the work.

Similar deterioration occurred at other ports, and roused engineers who suffered by it to investigate the causes of the trouble and the means of preventing it. One of the first tasks of the Concrete Institute (which was founded in 1909 and afterwards became the Institution of Structural Engineers) was to appoint a committee to deal with this question, and its report appeared in 1911. Later, in 1935, the Sea-action Committee of the Institution of Civil Engineers published the results of some very useful research work which had been carried out for them by the Building Research Station, D.S.I.R., and which indicated the precautions necessary to prevent deterioration of concrete and reinforced concrete in sea-water.

The earlier investigators were inclined to ascribe the trouble to electrolytic action; and indeed, in the case of the second jetty referred to in the foregoing, electrolytic action was, if not the sole cause, a very important contributory. The electric cranes which travelled on the jetty were worked by direct current at 480 volts on the three-wire system, the neutral wire being earthed to a steel-girder bridge at one end of the jetty. It was found that considerable amounts of electricity passed through the reinforcement from the bridge to the sea, and that this largely—but not entirely—accounted for the corrosion. The report of the Sea-action Committee ascribes the rusting of the reinforcement to the permeability of the concrete, and probably every port engineer who has experienced this trouble will agree with this view. It is true that reinforcement in piles and bracing below mean tide-level rarely suffers in this way, even though covered only by the same permeable concrete that fails to protect it at a higher level, but no doubt this is because air cannot reach steel that is always under water, even if the cover of concrete is permeable.

Thornycroft's jetty, which, as already stated, is 56 years old and still in excellent condition, was made with a very "dry" concrete, and the old-fashioned "ball" test was constantly applied during its construction to ensure the stiffness of the concrete. On the other hand, some of the later structures at Southampton were deliberately made with a "rather wet" mixture. It was considered that such a mixture, being more workable than a dry one, would be more likely to pass freely between the reinforcements and thus closely surround them. This, of course, is doubtful because a wet mixture tends to shrink away from the bars when setting, and we now realize that a high water-cement ratio involves a high proportion of air voids and thus produces a weak and permeable concrete. At that time we

*Reproduced from the Jubilee number of "Concrete and Constructional Engineering."

Early Concrete Marine Structures—continued

were fearful that, with crowded steel and a " dry " concrete, even careful ramming might fail to prevent honeycombing. The introduction of vibration has solved this problem, as it has enabled the use with safety of much drier mixtures than formerly, giving greater strength and greater impermeability. The success of the gunite covering at the Southampton Town Quay, previously mentioned, is no doubt accounted for by the close adhesion and impermeability of this material. Incidentally, it is interesting to note that in those early days we were eagerly in search of a method of quickly testing the permeability of the concrete structures we had erected. The new ultra-sonic method of testing (see this journal for November, 1954) seems to have solved this problem.

The introduction of prestressing has opened up another new field for concrete, and who knows what may follow? It is good to remember that the difficulties and failures from which reinforced concrete suffered fifty years ago and the persistence with which they were investigated and overcome have made it possible to extend the usefulness of this material.

Brooklyn Waterfront Reconstruction

Port of New York Rebuilding Plan

Plans for the reconstruction of a twc mile stretch of the Brooklyn waterfront have recently been announced. The programem is estimated to cost $85,000,000 and will be spread out over seven years. It comprises the construction of ten new piers, the rehabilitation of an existing pier, the construction of three new warehouses and the improvement of fifty acres of upland area.

The Port Authority's development of the Brooklyn waterfront has been made possible by the purchase of the properties of the New York Dock Company extending southward from a point near the Brooklyn Bridge to and including Atlantic Basin.

Construction of the first of the great new marine terminals, the $7,000,000 Pier 11, a three-berth quay in Atlantic Basin, will begin on July 1, 1956 and will be completed by the end of 1958. The quay will be 2,000 feet long and 270 feet wide. The single-story shedded area will be 1,800 feet long and 150 feet wide. A 20-foot-wide apron will be provided, and a 16-foot-wide truck loading platform will parallel the entire length of the land side to handle 144 trucks at one time.

The remainder of the two-mile development will be built over the seven-year period to assure the least possible degree of disruption to operations of occupants of the existing facilities.

The 10 new piers with 23 berths will be provided with 90,000 square feet of shedded space for each berth. The total shedded area of the completed project will be over 2,000,000 square feet as compared with the existing 1,500,000 square feet, an increase of about a third. Twenty-foot aprons and extensive truck service areas will be provided at each facility.

All of the piers will be built at an elevation of 12 feet above mean low water. Most of the piers in the New York Harbour today are about 9½ to 10 feet in elevation. As a result, there have been several instances in past years when floods following hurricanes, high tides and high winds have damaged cargo on the piers.

An increase in the width of slip space between piers from 200 feet to 300 feet will expedite the docking and departure of vessels. The rapid tidal flow in the area presents difficulties at present. The entrance to Atlantic Basin will be widened from 300 feet to 600 feet to permit easy negotiation of the 90 degree turn from Buttermilk Channel.

The fifty-acre upland area, now occupied in part by obsolete " Civil War " era multi-storey warehouses, will be cleared to provide 250,000 square feet of single-storey, efficient storage space and 45 acres of paved area to accommodate cargoes and handle the 3,000 trucks a day which comprise the pier cargo traffic. This type of truck handling will relieve the adjacent Brooklyn streets of congestion now caused by vehicles moving to and from the piers. At the same time, it will reduce the cost of freight trucking by eliminating street traffic delays in the area. It will also eliminate interference with ship loading, unloading and other phases of cargo handling.

The construction programme in detail is as follows :—

Air view looking south from Manhattan side of Brooklyn Bridge showing two miles of existing obsolete Brooklyn waterfront.

Pier 1—An L-shaped pier, immediately south of the Brooklyn Bridge ; two berths along its 1,030-foot frontage ; a third berth on its 570-foot south side.

Pier 2—Two-berth finger pier ; 625 feet long, 340 feet wide.

Pier 3—Two-berth finger pier ; 625 feet long, 340 feet wide.

Pier 4—One-berth finger pier ; 700 feet long, 300 feet wide with 100-foot-wide truck back-up area.

Pier 5—Two-berth finger pier ; 625 feet long, 340 feet wide.

Pier 7—Three-berth finger pier ; 725 feet long on north side, 1,100 feet long on south side, 300 feet wide.

Pier 8—Two-berth finger pier ; 750 feet long, 300 feet wide.

Pier 9—Three-berth finger pier ; 550 feet long, 570 feet wide.

Pier 10—Two-berth finger pier at northwest side of Atlantic Basin; 700 feet long, 320 feet wide.

Pier 11—On east side of the Basin ; a three-berth quay ; 2,000 feet long, 270 feet wide, with a shed 1,800 feet long, 150 feet wide.

Pier 12—At southwest side of the Basin ; the existing two-berth, 900-foot-long and 170-foot-wide pier will be completely rehabilitated. The vessel entrance to Atlantic Basin will be widened from 300 to 600 feet.

The following warehouses are to be constructed :—

Warehouse between Piers 4 *and* 5—380 feet long, 113 feet wide ; 43,000 square feet of storage space.

Warehouse behind Pier 9—430 feet long, 220 feet wide ; 95,000 square feet.

Atlantic Basin Warehouse—On south side of the Basin ; a single-storey warehouse ; 400 feet long, 280 feet wide ; 112,000 square feet.

View looking south from Manhattan side of Brooklyn Bridge showing the Brooklyn waterfront as it will appear upon completion of the 7-year development programme.

Brooklyn Waterfront Reconstruction—continued

The Port Authority plans to employ contractors for the continuance of the public storage activities that have for several years existed in the Dock Company property. It will solicit applications from responsible private warehouse firms in order to select a warehouse agent in the same manner as that followed at its warehouse operation in Port Newark. Under this type of operation the warehouse performs all of the operational duties. He is compensated through the payment of a percentage of gross revenue to cover his expenses and services. The Authority, however, will be responsible for the establishment of rates and the warehouse receipts will be issued in its name.

The Port Authority has indicated that prosperity in the Port of New York in the years ahead calls for the fulfilment of three basic

Atlantic Basin as it appears today with narrow, crowded piers with restricted space for vessels.

Close-up of reconstructed Atlantic Basin. On right is three-berth quay (Pier 11), 2,000-ft. long by 270-ft. wide with shed 1,800-ft. long by 150-ft. wide. This will be the first of the great waterfront structures to be provided in the Port Authority's 7-year master plan. At left (North end of Basin) is a new 700-ft. long by 320-ft. wide pier (Pier 10). At left (Southwest end of Basin) is an existing pier (Pier 12), 900-ft. long by 170-ft. wide to be completely improved and modernised. The vessel entrance to the Basin will be widened from 300 to 600-ft. In the foreground is a new single-storey 400-ft. long by 280-ft. wide warehouse to provide 112,000 sq. ft. of storage space.

requirements. The first requirement is the provision of " the most modern and efficient facilities and the most complete port services available anywhere " ; the second, " protection against transportation rate structures that discriminate against us " ; and the third, " promotion of the advantages of shipping via the Port of New York."

The purchase and development of the New York Dock Company facilities in Brooklyn, perhaps the largest privately owned marine terminal in the world, is considered to be a long step toward assuring future port prosperity.

The Problem of Storm Surges

Investigation by Liverpool Observatory and Tidal Institute*

It was reported last year that the Ministry of Agriculture, Fisheries, and Food were expecting to authorise the Liverpool Observatory and Tidal Institute to undertake a programme of research work on the subject of storm-surges. Treasury sanction for the work was received at the end of the year and most of the research work done during the year has been in connection with this subject. It is likely to continue for at least another year and so far there have been no final conclusions on any portion of the work.

The specific problems were originally set out by a sub-committee of the Waverley Committee in its Report of the Departmental Committee on Coastal Flooding (H.M.S.O., 1954), from which the following is quoted:—

" The specific problems of research which await solution in order that improvements may be made in the system of forecasting storm surges, and institutions to which such problems should be submitted."

(1) The analysis of tidal records for those stations at which hourly readings are required for the warning system.
(2) The search for empirical formulae by which surges at Leith, Tyne Entrance, Immingham, King's Lynn, Lowestoft, Harwich, and Southend can be predicted as far in advance as possible.
(3) Investigations on the surge oscillations which occur at Leith, Tyne Entrance, Immingham, King's Lynn, Harwich, Southend, and Dover, with a view to finding their relationship to the time and height of the maximum surge.
(4) A study of the interaction between the tide and the surge.
(5) The search for formulae which will enable external surges, as recorded at Aberdeen, to be forecast from meteorological data.
(6) The carrying out of studies, like those already carried out for the surges of the North Sea, on surges in the English Channel, the Bristol Channel, and the Irish Sea.
(7) The nature, extent, and rate of response of the sea surface to winds of different intensity, duration and fetch, and the modification of long waves and surges in shallow water.
(8) A study of the free and forced oscillations possible in the North Sea."

The Committee recommended that research on items 1 to 6 above should be carried out by the Liverpool Observatory and Tidal Institute, and on items 7 and 8 by the National Institute of Oceanography, in each case in consultation with the Meteorological Office. This recommendation was approved by the Advisory Committee for Oceanographical and Meteorological Research which was afterwards set up by the Ministry of Agriculture, Fisheries, and Food.

Both the above-mentioned committees were placed under the chairmanship of Professor Proudman, and representatives of all participating bodies are on the Research Committee. The Hydrographic Department acts with the Meteorological Office in the collection of information for the warning system and for purposes of research. There has been very active co-operation during the year. It should be remarked that the subjects listed above are not exclusive of one another so that this co-operation is necessary and valuable.

In the main the problems referred to the Institute are of a practical nature in that usable formulae are expected to emerge from the investigations, but theoretical work is necessary in all cases. This is especially so in the case of item (4) and the Director has made this subject his special activity, though, of course, he assists Mr. Rossiter and Mr. Lennon in their special work, for the North Sea and the Irish Sea, respectively.

The interaction of tide and surge is of special importance because the interaction is a factor in restricting the maximum height of tide and surge. It was noted by the Director in his report on the Thames Floods in 1928 that the largest apparent surges tended

*Extracts from Annual Report for 1955.

The Problem of Storm Surges—continued

to be more closely associated with low water than with high water. Several reasons for this effect were known to exist but only qualitatively. The urgent necessity is to obtain some kind of quantitative result so that for any state of distribution of wind and air-pressure the computed height of surge could be modified according to whether it would be consummated with high water or low water or would occur at an intermediate state of tide. If, for instance, a surge of magnitude 10-ft. has been apparent at low water, what would have been the apparent surge if it had occurred at high water? Up to the present time no definite answer has been obtained to this question.

The problem has been attacked by Professor Proudman in two important mathematical papers, and he has shown that the most important agency for modifying the apparent surge is that of friction, and that quantitative indications are in general agreement with the observed facts, but the mathematical difficulties are so great that his results are not applicable for more than short distances along channels. The Director has explored methods of numerical integration for a uniform channel about 100 miles long with fixed elevations of tide and surge at the mouth. Even without the presence of the surge the problem of computation has always been regarded as a formidable one but satisfactory methods were devised for the tide alone. A surge has been superposed and the programme is to study the variations in the results as the phases of the tide and surge are varied.

One problem in this numerical work is that of the law of friction. The usually accepted law is that the frictional forces vary as the square of the velocity of tidal stream but take the sign of the stream. This law, however, is most unsuitable for numerical work as it gives discontinuities after differentiation. Work has therefore been done by taking the frictional force proportional to a linear combination of velocity and the cube of the velocity, the constants being chosen so as to agree with the square law for the maximum stream in any section under consideration.

Certain important results have been obtained. One is that the apparent surge at the mouth of any channel closed at one end is not representative of the surge in the open sea. This is readily shown by considering an incident wave travelling inwards from the sea and a wave reflected from the closed end of the channel. The resultant may have two peaks if the incident surge is one with a sharp peak, and in general the surge at the mouth will be broader than that in the sea or at the head of the channel. Another important result is that in many cases, especially when there are tidal movements, free oscillations may be set up, with a period depending upon the length and depth of the channel.

The existence of free oscillations has been known for some years and one of the difficulties in determining the apparent surge from tide-gauge records is the existence of these free oscillations. Very great efforts have been made to determine the part of the tide-gauge record which may be attributed directly to the meteorological disturbances and most of the year has been spent in obtaining data for Aberdeen, Immingham, and Southend, in the North Sea, and Avonmouth, Liverpool, and Belfast on the west side of Britain. These places have been chosen as covering two of the areas for investigation. It is expected that when there are empirical formulae for these places then it will be easy to obtain formulae for intermediate places.

Of the problems listed above, next to item (4) is that of the external surges which travel southwards from the north of Scotland. These have been closely studied by Mr. Rossiter for Aberdeen, with some satisfaction but not to the extent that one would wish. It is not likely that this problem can be adequately solved without data from the north coast of Scotland, for which we have to await results from new tide-gauges which are being installed. But Mr. Rossiter has shown that some of the effects are due to water which has been forced out of the North Sea by southerly winds and that this water returns as a free wave some 14 hours after the meteorological conditions over the North Sea which appeared to give rise to the effect. This is in accordance with a conclusion reached also by the late Dr. Corkan.

Another result is that in some cases it is necessary to have separate formulae for different types of meteorological disturbances, due to the fact that a south wind may have an effect which is not the same in magnitude, but of opposite sign, to that of a north wind of equal velocity.

Reverting to the matter of the determination of surges a memoir on this subject was prepared last year and it has been modified a little in the light of this year's experiences, particularly with observations for Avonmouth, where there are such large tides that their elimination from the record is a matter of very great difficulty. Indeed it may be stated that the difficulties of the subject are far greater on the west of England than they are on the east, so far as this part of the work is concerned. There is also a great difference in the character of the surges; in the Bristol Channel the surges show very sharp peaks at certain stages of the tide. Forecasts will also be difficult on the west coasts because of the lack of tide-gauges further west and south-west.

Surges in the Thames Estuary.

It was reported last year that an investigation had been made by the Hydraulics Research Organisation as to the indications of a water model with a surge comparable with the 1953 surge superposed upon the tides. This investigation had specially in view the operation of a surge-reducing barrage which was intended to keep London free from the dangers associated with large surges. The results were described in a paper read before the Institution of Civil Engineers, and the Director of the Tidal Institute was asked to contribute to the discussion. He pointed out that the experiments needed to be interpreted in that there was evidence of a free oscillation set up between the barrage and the input mechanism. These comments led to further experiments which showed the correctness of the comments. The question had been raised as to whether the barrage would cause higher elevations of water seaward of the barrage, by reflection from the barrage seaward, and in the course of its travel meeting the incoming tide.

The Director chose this as part of his investigation of numerical methods of integration and his results showed conclusively that the barrage would not cause added dangers seaward. The following is an extract from information contained in the Report of the Hydraulics Research Organisation.

"An analysis of the model results was made by the Liverpool Observatory and Tidal Institute, from which it emerged that for 90 per cent. or 100 per cent. closure 2 hours before high water, the high water level would exceed the unobstructed tide-plus-surge by about 0.5-ft. at Southend and by about 0.7-ft. halfway between Southend and Tilbury. Such cases, however, were largely of academic interest for it was not proposed to delay closure until 2 hours before high water. For the practical case of 90 per cent. closure 4 hours before high water, it was estimated that the high water level at Southend would be unaffected and the high water levels between Southend and the barrage would be lower than those of the unobstructed tide-plus-surge.

At Tilbury and at the point 750-ft. downstream of the barrage the reduction would be about 2-ft. There was therefore no cause for anxiety that the barrage would give rise to higher water levels downstream. For 100 per cent. closure 4 hours before high water, the level at Southend would be raised by about 0.5-ft. and by lesser amounts between Southend and the barrage, but 100 per cent. closure would in any case be impracticable for the reasons already given. All these results were calculated for the 1953 storm surge conditions.

The results of the model investigation were used by the Thames Technical Panel in drafting their final report, which deals largely with the practicability of the barrage scheme. The Report has been submitted to the Minister of Housing and Local Government."

Inter-American Port Conference

The Organisation of American States has announced that the first inter-American port and harbour conference will be held in April at San Jose, Costa Rica. The conference is sponsored by the O.A.S. Inter-American Economic and Social Council. The preliminary agenda covers port administration and operation.

There will be emphasis on port regulation, terminal operations, warehousing, cargo-handling, cargo loss prevention, port congestion and the use of free trade zones.

Harbour Radar Installation at IJmuiden

North Sea Canal Amenity

"The first harbour radar station on the continent of Europe." These words are inscribed on a memorial stone at the foot of the semaphore Tower at IJmuiden, in the top of which, 85-ft. above water, the radar station is located. The station was inaugurated by H.R.H. Prince Bernhard of the Netherlands on November 1st, 1951. It is the property of the city of Amsterdam and is operated by the Government Pilot Service.

IJmuiden is the port of entrance to the North Sea Canal by which the port of Amsterdam (second in importance in the Netherlands, Rotterdam being the first) is connected to the North Sea. The 13 nautical miles long canal is entered through locks at IJmuiden. The Outer Harbour is formed by two stone moles each about 0.7 mile in length, the navigable width of the entrance being about 600-ft. The approach sea area wherein IJmuiden harbour radar is used may be seen roughly as a semi-circle with a radius of 8 nautical miles. Its diameter runs approximately parallel to the coastline, and over both light structures on the moleheads, in a 014°—194° direction. Between the entrance lights, this direction is bisected at an angle of 90° by the leading lights in line, bearing 104.5°. Outside the 10 fathoms line the sea is clear of obstructions and shoals.

Assisting a ship by radar in this area is much less complicated than, for instance, in Liverpool Bay, where harbour radar was put into use in July, 1948. When visibility is reduced, Liverpool Harbour Radar, only on request, assists vessels moving in both directions in the 13 miles long curving approach channel in the Bay, between the Bar Light vessel and the dock area along the Mersey. The radar operators give direct radio-telephonic information on the traffic and on the state of the port and of the dock entrances. Further information is passed to the men on the bridges of vessels, regarding their position in the channel in respect to moving and stationary vessels.

IJmuiden Harbour Radar is manned from the moment visibility becomes less than 10,000 metres (5.4 miles). Its aim, when visibility is poor, to assist incoming ships to reach the entrance to the Outer Harbour by transmitting to their bridges information concerning their positions. The pilot who boards an incoming ship from the cruising pilot-steamer carries with him a portable radio-telephone set, weighing 14 pounds. If, because of low visibility, the harbour entrance is not in sight, the pilot may call the radar operator in the station on the Semaphore Tower on his phone and ask for assistance.

As soon as the operator knows which echo on the harbour radar screen needs assistance, he starts telling the pilot over the radio-telephone:

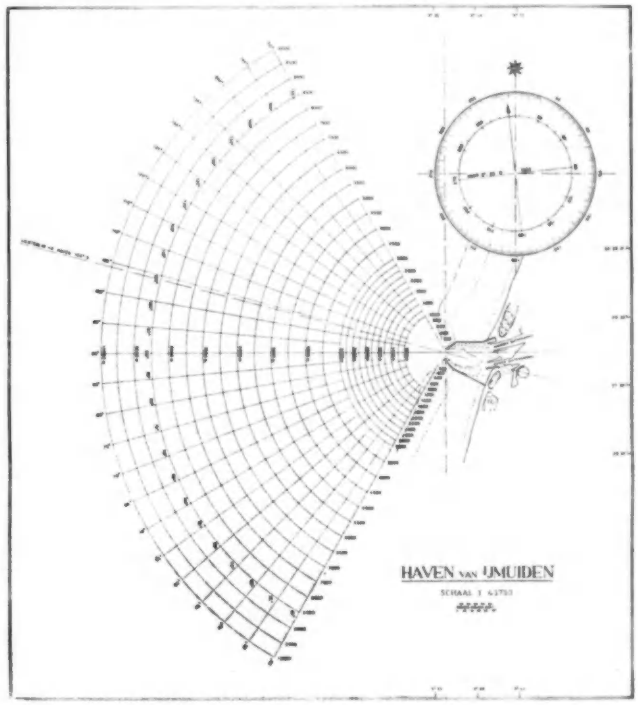
(a) the true bearing of the middle of the harbour entrance, from the pilot's ship;
(b) the range to the middle of the harbour entrance in metres.

In case there are more echoes on the harbour radar screen the operator will be able to identify the ship, by asking the pilot to let her make a turn, either to port or to starboard.

While the operator continues to give these data the pilot realises the position of this ship with respect to the harbour entrance and any alteration thereof, and knows when the entrance will be reached. The radar operator also gives all available information on the traffic in the sea area as well as in the harbour area and near the locks. The pilot also brings on board a plotting chart of the sea area and IJmuiden Outer Harbour for the use of the ship's captain. There is a loudspeaker on the receiving set of the radiophone, so that everyone on the bridge can hear the operator. The position of the ship can easily be plotted on the chart, thus the captain is able to check his progress. For foreign ships the telephonic commands are given in English.

The radar operator gives the position of the ship he is assisting respective to the point where the line of leading lights intersects the line joining the two harbour entrance lights. This point is named here briefly: O.

The radar station in the tower of the semaphore stands 1500 metres (1,650 yards) inwards from point O nearly in the line of the leading lights. Usually the position of the scanner of a radar station lies in the centre of the radar screen, directions and ranges of echoes taken by the observer, are in respect to the position of the scanner. Because of the distance between the scanner of IJmuiden harbour radar station and point O in the middle of the harbour entrance, the "of centre" system has always been used. "Of centring" means: to move the radar picture across the screen until



The plotting chart for Ijmuiden, which is used by pilots on board ships. The operator of the harbour radar station transmits the position of the ship in bearing and range in relation to the middle of the harbour entrance. By marking these data on the plotting chart, the pilot knows exactly where his ship is. The line of leading lights is marked on this chart on 104°.5.

The operator behind the indicator of the harbour radar installation. The different scales of the images can clearly be seen: the operator is handling the two controls for range and bearing.

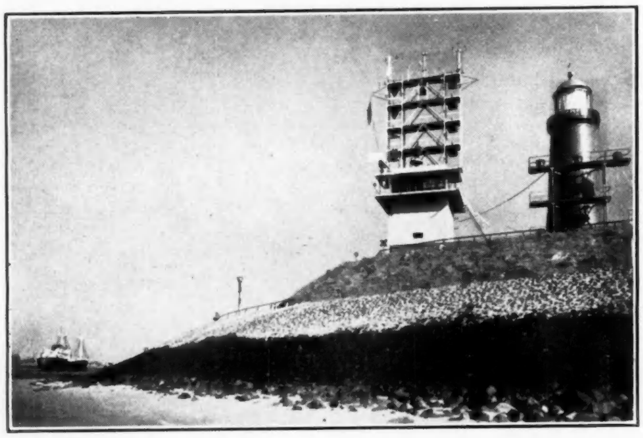
Harbour Radar Installation at Ijmuiden—continued

another and previously selective point is brought into the centre of the radar screen.

By the "of centre" system harbour radar can be properly used, in such a way that the operator is able to determine the direction of an echo and its range to point O, by using a rotating cursor and a range scale graduated in metres.

The specifications of the radar installation were made by the "Nederlands Radar Proefstation" (Netherlands Radar Research Establishment) Noordwijk as a result of a survey held by this establishment. Also the "of centre" system was designed by Nederlands Radar Proefstation. The installation was built and constructed by N.V. Philips' Telecommunicatie Industrie (Philips Telecommunication Industry), Hilversum. Technical data of this installation are as follows:

Frequency ranges	9,000—9,309 Mc/s.
Pulse width	0.09 m/sec.
Recurrence frequency ...	3,000 p/sec.
Ranges up to:	10,000 metres (11,000 yards).
Minimum range	85 metres.
Diameter of screen	16 inches.



The semaphore at the entrance at the port of Ijmuiden. On the roof of the semaphore is the radar-scanner.

The scanner of the parabolic cylinder type is made of aluminium.

Speed:	12 revs./min.
Total Weight	2,600 lbs.

In the beginning the operating range-scales were 10,000 metres and 3,500 metres. In the radar operating room at the station two separate indicator units are placed next to each other on one deck. Thus two pictures to different scales and with independent of centre positions permit simultaneous observation by the operator. By this arrangement interference with the clearness of the picture by afterglow, after the scale is shifted, can be avoided.

Although the diameter (16-in.) and the flatness of the screen are suitable for measuring ranges in the radar picture, there were also parallax errors due to the thickness of the glass of the screen and to the distance of it above the actual picture. It was decided to discontinue the existing mechanical way of determining bearings and range of an echo by rotating cursor and a scale, and the "Raplot" was developed by the Nederlands Radar Proefstation and constructed by N.V. Philips.

The Raplot makes it possible by means of an electronic device, to determine range and bearing from any preselected point in the radar display to any other point in it. By operating a foot switch (the operator needs both hands all the time) the display is temporarily suppressed, and a thin electronic cursor appears in the radar picture, which is still visible by its afterglow. By turning the bearing control on the panel, the electronic cursor revolves round the preselected point in the radar picture and for IJmuiden Radar this is the afore-mentioned point O in the middle of the harbour entrance. When this cursor is brought over an echo on the screen the bearing of point O from this target can be read directly to a tenth of a degree on a large illuminated bearing scale on the front panel of the indicator. By turning the range control an electronic variable mark moves along the cursor, and by bringing this mark to a target the range in metres from the target point to point O can be read directly on the illuminated range scale. Bearing and range finding takes only a moment, and immediately afterwards, by releasing the foot switch, the display returns again.

Because with Raplot the electronic cursor moves in the actual radar picture, there is no parallax and inaccuracies in range and bearing are non-existent. The accuracy of bearing has been proved better than 0.5° and of measured ranges better than 0.5 per cent. of the indicated range.

With the introduction of Raplot in 1952 the maximum range has been raised, and the minimum range reduced. There are now three operating range scales: 15,000 metres (16,500 yards), 3,000 metres (3,300 yards) and 1,000 metres (1,100 yards), although these three range scales can be used on either display, it is customary to keep one of them for the first and third range scales and the other one for the second range scale only. The pilot on a ship that is moving within the 1,000 metres range will, if necessary, be kept informed on the distance of his ship from point O, but instead of the bearing of point O, the operator gives the pilot the distance of his ship, at right angles, from the leading lights in line. In this case the operator turns the electronic cursor round point O, until the bearing scale reads 104.5°, this being the bearing of the leading lights in line. The cursor then presents the leading line, and the shortest distance from the target to the line can be measured with a small graduated scale. Next the cursor is put over the target, to find the distance to point O.

Within the 1,000 metres range the course made good of a moving vessel is often clearly marked by the afterglow.

IJmuiden Harbour Radar assists ships to find the harbour-entrance when visibility is low, but it remains, however, for the captain, advised by his pilot, to decide how his ship shall be manoeuvred. Once a ship has safely entered the Outer Harbour, it may be judged necessary for the operator to continue his assistance. In this case he turns the electronic cursor 180°, until it presents the leading-line within the harbour, and he keeps the pilot conversant with his ship's range from the leading-line and from navigation marks, dolphins, vessels at anchor and from other objects that must be passed.

Ships such as fishing vessels usually navigating without a pilot and equipped with a radiophone may call IJmuiden Harbour Radar via Scheveningen Radio for information and radar assistance when visibility is bad and when navigating towards the harbour entrance. In such cases the radar operator passes his information to the man who holds the receiver. Raplot is also a very important aid to the coastguard. When a ship at sea is in distress or for some serious reason calls for assistance or for tugs, darkness or bad visibility often hinder the vessel that goes out to assist. If such a such has been identified on the screen of the indicator of a radar station the operator at once starts working the Raplot. If the target remains stationary as in the case of a ship aground or stranded the point round which the electronic cursor revolves is brought on the echo of the ship that has called for assistance. From then on the radar operator will be able to direct the assisting vessel to find the mark by bringing the cursor over his echo and by keeping the captain continuously informed on his bearing of and range to the ship that he intends to assist. In similar cases communication between the radar operator and the captain of the ship that is giving assistance has to be maintained via Scheveningen Radio.

When the ship in distress is not aground or stranded, its echo will move on the screen. Then the electronic cursor has to be moved with it. In such a case, however, it is preferable to take a fixed reference point on land near the coast, such as a lighthouse beacon or any other object which is conspicuous on the radar screen. The echo of that object will be the point round which the electronic cursor revolves. Continuous transmission of bearings and ranges from this reference point of the ship that is drifting along, to the captain of the tug or the lifeboat with this local knowledge will be sufficient for him to find the ship he is trying to locate.

The installation at IJmuiden is to be regarded as the first in a chain of radar stations which will monitor the passage of ships all the way from the North Sea to Amsterdam. This chain is in course of construction and is expected to be completed in the latter part of this year.

Waterside Rodent Infestations

Experimental Control of Rats on a Warehouse Frontage *

By H. HARRISON, F.R.SAN.I., A.M.I.S.E., M.S.I.A.,
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Introduction.

BRITAIN'S third seaport, Kingston-upon-Hull, lies on the north bank of the Humber at the confluence of the River Hull and the estuary. There are along the Humber bank about eight miles of docks and quays. The River Hull joins the Humber at a point about half-way along the frontage. Both waters are tidal.

There are numerous warehouses and wharves on the banks of the River Hull, but only on the west bank of the lower portion of the river, near its mouth, were the first experiments tried out, mainly on the site of what is known as the Old Harbour, reminiscent of sailing ship days.

Site of Infestation.

From the River Hull mouth to about a quarter of a mile up-river the banks are 150-ft. to 240-ft. apart. The depth of water varies from 16-ft. to 24-ft. at high tide, and 4-ft. to 10-ft. at low tide. The average rate of flow in the river is about 3 to 4 knots increasing with the ebb tide. Along the banks are mainly warehouses, some of which are of recent construction, others having been used for a considerable number of years. There are, however, buildings along this stretch of river which form the oldest part of this city and were erected in the mid-eighteenth century. Fronting most of these buildings are wooden quays where the lighters and river craft discharge their cargoes (see Fig. 1).

A few of these buildings along this part of the river were known to be rat infested, but despite treatment by the city health department there always remained a small residue of rodents. One or two of the premises were infested by the black rat and the remainder by the brown species. Attempts were made to reduce this infestation by placing poison on the mud banks under the quays at low tide. This method reduced the infestation for a brief period only and it was decided to see if a more positive result could be obtained.

Initial Experiment.

In the early spring of 1954 the mud banks under the quays along one side of the river showed evidence of a fairly serious infestation. Sewers of the small streets called staithes which terminated at the quays discharge their contents directly into the river. The outlet of each sewer was fitted with a flap valve. Accumulation of mud and debris made it impossible to determine whether the rats gained access to the mud from the sewer outlets, or through the retaining walls. The latter vary in construction, parts are of timber, others brickwork, while the modern buildings have concrete retaining walls and quays.

One method, of course, would have been to secure ropes to the horizontal beams and allow the free end of the rope to remain in the rodent tracks on the mud. Any bait placed on these timbers would in most cases be washed away owing to the variation of tidal levels and the wash from river craft. It was therefore decided a float would appear to be the most suitable means for placing the pre-baits and subsequent poison.

A raft constructed of old floorboards was made 2-ft. 6-in. long and 1-ft. 6-in. wide. The container, fixed in position by three wire stays in the middle of the float, was 6-in. in diameter, 3¾-in. high, and made of white enamelled metal. Actually this was a familiar article with the handle removed. The float was placed in the wake of river craft, but the curve of the container side enabled it to resist water from this direction.

In order to prevent birds from eating the poison, a cover 1-ft. 4-in. long, 1-ft. wide, and 7½-in. high, was made. The wood frame was 1½-in. by 1½-in., a plywood top being covered with bituminous felt. To allow ingress for the rats, the sides were made of open lattice work, the bottom lath being 2-in. from the base of the float. The cover was attached to the float by hinges, and a staple enabled it to be padlocked if necessary.

For buoyancy, 25 cork slabs 3-in. by 3-in. by 1-in. were fixed to the underside of the float. These counteracted the weight of the two metal anchor chains which retained the float on the mud at low tide, and formed an anchor as the water rose. The chains were japanned straight metal weighing 7 ounces per yard.

The float was placed under a quay and baited with 1 lb. of damp sausage rusks. It was deemed necessary to inspect the float daily, but it was not until 12 days had elapsed that the rats commenced to eat the bait. After this they ate nearly 1 lb. a day. The white enamelled side of the container provided a further check to be made on the number of rodents eating the pre-bait, as the well-defined mud smears formed thereon indicated the interest shown in that bait and the foot prints told the sizes of the rats.

First Treatment.

August, 1954, was selected as the earliest and, because of the low tides, the most opportune period for the first treatment of the river mud banks. By now, following trial

Fig. 1.

*A Paper presented at the 62nd Annual Conference of the Sanitary Inspectors' Association held at Scarborough, September 1955, and reprinted (slightly abridged) by kind permission of the Association.

Waterside Rodent Infestations—continued

and error, nine floats had been constructed, and these were fixed in position, each about 60 yards from its neighbour. (Figs. 2 and 3 show a float on the mud, and rising with the tide.) Again sausage rusks was used as the pre-bait and there were negligible results until 12 to 14 days had elapsed. Two of the floats sank several times in each week; the

Fig. 2.

Fig. 3.

reason for this was not discovered until later experiments took place. These floats were removed and poison—5 per cent. mixture of zinc phosphide—placed in the remainder. The poison was checked daily and removed at the end of three days. The total weight of poison consumed was 48 ounces, an estimated kill of 96 rodents.

Retaining Wall Infestations.

The foregoing has dealt with rodents on the mud banks. In November, 1954, attention was drawn to a small infestation in one of the dock walls. This wall was constructed of open jointed masonry laid at an angle of 45 degrees; there was 10-ft. variation in the depth of water, and on the occasion of highest water level the water was only about 2-ft. 6-in. from the top of the wall. Checks were made that at quiet periods the rats travelled over all the exposed surface of the wall. The use of the floats enabled the bait to be laid at various positions on this surface, by shortening or increasing the length of the anchor chains. Five floats were placed on the wall (see Figs. 4 and 5), and pre-bait laid therein. A few days later flooding of various parts of this city occurred, with strong winds of 25 to 31 miles velocity. Heavy rains occurred, and had the normal method of baiting been used the latter would undoubtedly have been washed away by the rain running down the wall. Unfortunately, all the floats turned turtle, and it was realised if this method was to be successful during storm periods, further buoyancy was necessary. When the weather abated the pre-bait was relaid, and after three weeks' continuous treatment it was estimated 32 rats were poisoned.

Ministry of Agriculture and Fisheries Infestation Control Division Experiments.

The Ministry's area Technical Officer had been informed of this work and had made several visits to see the floats in operation. A request was made that they should con-

Fig. 4.

tinue with the experiments. By agreement it was arranged that the officer would try an oil bound warfarin mixture in floats to be laid on the River Hull bank, in about the same position as the first treatment. The opportunity was taken of increasing the buoyancy of the floats by replacing the cork slabs with disused lifebuoys (see Fig. 6).

The Ministry's experiments commenced in the middle of January, 1955. In addition to the Warfarin another form of prepared poison was used. Fourteen floats were laid, the longest anchor chain on this occasion was 20-ft. and the shortest 8-ft. The floats became waterlogged on several occasions, but this was unavoidable as they became jammed

Fig. 5.

Waterside Rodent Infestations—continued

against the underside of the quay during unforeseen high tides.

After a month it was estimated there were only negligible quantities of Warfarin eaten by the rodents, and even less of the other poison. (The poisons were in separate containers.) The floats at the time of removal were beginning to lose their buoyancy, due to long immersion in the water.

No apparent solution could be found for the failure to take the baits, because there was evidence that rats had run on to the floats. It could only be assumed that there was a similarity between the warfarin mixture (composed of pinhead oatmeal, sugar, warfarin and liquid paraffin), and the spillage from the warehouses, both being of a grain character and having a somewhat similar oil content. The rodents, therefore, were not attracted by this type of bait. Preceding this treatment the buoyancy of the floats had been increased, and during a trial period sausage rusk pre-bait was placed in the container of one float. On this occasion the rats ate the food.

It had been intended when this treatment was completed to send the Warfarin to the city analyst in order to ascertain whether there had been any variation between the residue and a fresh mixture. Unfortunately, the floats became waterlogged the night before they were to have been removed, and the contents lost. It was thought at one period that bait might have been rendered unpalatable by absorption of salt from the inflowing tide or from windblown spray, but sausage rusks which had been in a similar position showed when analysed no variation from a fresh mixture.

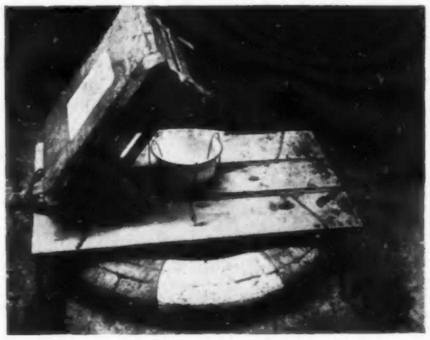


Fig. 6.

Conclusions.

The size of these floats and type of anchor chain should not be taken as a standard but rather as a basis from which others could be designed. The flow of water, available space, and whether the rodents are on the river bed or a sloping bank, are factors which must be considered before constructing the floats.

The winter weather, with its easterly winds, abnormal tides and glutinous soft mud, had an adverse effect on these experiments. At other periods of the year the floats proved a much better method than any of the other known arrangements. A quick-acting poison is recommended, since the floats require frequent and regular inspection when in use, especially on a site such as this, where tides are swift, river craft numerous and the waterway narrow.

New Inventions and Methods for the Dock Engineer

By J. Lomas.

Over the past year developments of interest to the dock and harbour engineer have occurred in various parts of the world, and in particular new inventions and methods have placed at his disposal tools designed to facilitate his work and lead to economies in operation. For example difficult power and steering problems are being solved by means of outboard propulsion and steering units, which are designed for heavy duty. These are quickly and easily installed for immediate use, are efficient, economical to operate and maintain. They have many special features not found with ordinary marine power. In consequence they render available easily installed power, better steering control, safety in shallow water, easier maintenance, more efficient performance, simpler hull design, more cargo space, etc., according to the claims made. Harbourmasters in particular will appreciate these advantages.

Cement Waterproof Paint

A new ready mixed cement-base paint is designed to prevent the seepage of water into underground structures, and can be applied on a dry wall. Unlike similar paints, this may be applied without the need of saturating the surface with water before and after application. The coating cures into a stone-like water barrier which allows the underlying masonry to breathe, but does not allow water to pass. It is being used to protect warehouses from exposure to water.

For loading-docks and other storage areas an auxiliary jib crane is now being used for multiple lifting and handling operations involving loads up to 15 tons. The crane revolves a full circle in either direction and can serve 1,936 sq. ft. of floor space.

Designed to move barges on short hauls and around river harbours is a new type of towboat measuring 70 ft. and having 580 h.p. These represent a new idea in river transportation equipment, being less than half the size of the long-range towboats that usually ply on inland waterways, yet they have many of the features of the larger vessels. Unlike previous boats of this size they have internal passageways to all quarters. There are two diesel engines and the smokestack has been eliminated, exhaust being discharged from small pipes.

Restoring Leaky Roofs

Even roofs that have badly deteriorated may become watertight when resurfaced with a new woven fibreglass material, which is easily applied and economical. The material consists of an open mesh woven glass fabric which allows bitumen coatings to penetrate through the mesh, surround the glass fibres and unite with the underlying surface. No time or labour is wasted in applying base and finish coatings, because the entire coating is applied directly over the membrane. The surface is tough and unified, retaining the essential volatile oils of the bitumen. The material may also be used for waterproofing floors, horizontal sub-surfaces, bridge decks, etc.

Fire Warning Devices

Automatic devices to give earlier warning of fire have been improved. Three of the latest advances in this field include photo-conductive cell detectors operating on the principle of modulated radiation by flame. The cell picks up the varying radiation and flicker emitted by the flame and sends a pulsating signal to the control panel, which actuates the fire-warning system. An electric eye smoke detector is another device. This can be placed to monitor an air-sampling pipe or air duct. An alarm sounds if smoke cuts down light received from the source or increases reflection to the cell. Lastly, a pneumatic system operates on the rate-of-rise principle. Air in a bulb or tubing expands and creates pressure against a diaphragm that, in turn, makes electrical contact or throws a switch. A calibrated vent prevents operation from normal temperature changes, usually under 15 to 20° F. per minute.

The use of radioactive tracers is being employed in Britain by engineers to show how the mud of the river Thames is distributed. Small quantities are used and this is expected to facilitate the dredging of the river and its blocking at strategic points, so that more shipping can be put into the dock area without causing problems of pilotage.

Anti-corrosive Coatings

Resistance to salt and fresh water is being obtained by means of a heavy aluminium coating, in which pulverized aluminium is combined with a vinyl resin vehicle to form an extra-heavy protection for steel, wood, concrete and other surfaces. The coating can be applied by brush or spray to 8 to 10 mil. thickness in a single application, which is nearly three times the thickness of conventional aluminium flake finishes. The coating hardens completely in 6 hrs., and can then be filed, buffed or burnished. Good resistance is also obtained to crude oil, petrol and low temperatures. The material acts also as a waterproof sealer and smoother for concrete.

From Sweden comes a method of driving piles into rock shoal, so reducing side slipping on underwater slopes. The pile used is hollow

New Inventions and Methods—continued

and allows a drill to operate through it. After the pile has been driven, a hole is bored 30 in. into the shoal. The drill is then removed and a 60 in. long steel dowel is dropped to the bottom of the hole.

Aluminium anchor chains are being used in some small Canadian harbour craft. The aluminium has high strength and non-magnetic properties, and the chain into which it is formed has a tensile strength of approximately 34 tons per sq. in.

Improved Tarpaulins

Even the common tarpaulin with which so many commodities and appliances are covered has been improved. Nylon and neoprene synthetic rubber are being bonded together to make tarpaulins claimed to be far superior to those made of duck. The life is said to be three times as long and the tear strength up to six times greater.

For loading a boat or pulling a motor out for repair, a pull-a-way weighing less than 9 lb. but capable of pulling or lifting a ton and a half, is now available. Engineering features of this appliance are similar to those of larger hoists. There is a double interlock that prevents the brake from slipping, an automatic notch-per-cycle let-down that assures positive control, and a safety handle to prevent serious overloading. Single strand, its 14 ft. cable will take a 1,500 lb. pull ; double strand, it will lift 3,000 lb.

From Britain again comes a standardized supporting structure that provides storage platforms or working areas by dividing the available height and thus doubling the available floor space. It is made up of tubular columns resting in base plates ; beams, bracing tubes, wedges, handrails and open steel or aluminium flooring. The system can be applied to meet varying conditions—loads per sq. ft., heights and grid dimensions.

In bridge construction, high winds and deep water sometimes rule out conventional methods of erection. In California, the most satisfactory answer to these conditions has proved to be an aluminium falsework truss, light enough to be hoisted in place by equipment already in place for other phases of erection. Temporary timber bents on the concrete piers supported the aluminium truss, after which the next step was to lift the span on the bents. On the first span this was done with floating equipment. All later spans were, however, hoisted by a floating rig and a traveller mounted on the floor beams of the previously erected span. When the aluminium span was set in place, steel was erected on top of the traveller. Jacks lowered the finished truss from the aluminium span to the steel piers. The aluminium span was then lowered on to a barge, moved between the next two piers and raised into position.

Re-vibrating concrete just before it reaches its first set is said to have many advantages, rendering the material stronger, denser, more uniform. Although re-vibration is effective in ordinary concrete it does even better when the set is retarded. For example, the tower spandrel beams on a large bridge in America were poured in four 3 ft. lifts. To prevent cracking in the bottom surface as concrete is placed in higher lifts, the entire mass is kept fluid with a retarder. The full depth was then re-vibrated. By ensuring sufficient time for the re-vibration, the retarded concrete yielded a considerable improvement in both uniformity and 28-day compressive strength.

Mechanical Handling

Modernizing the materials handling arrangements at ports is reducing congestion, handling costs and surcharge on discharged goods. The new system adopted in a large Peruvian port adopts fork-lift trucks, tractors, trailers, straddle trucks, cranes and roller conveyors. Ten thousand pallets have been bought, piers, warehouses and roads improved. A new accounting system keeps track of all cargo from receipt to delivery. The loaded pallets are moved from ship to warehouse in " trackless trains ". The combination of tractor and trailer replaces the original light railway and wastes no ship unloading time. Trailers with loads up to 30 tons are hauled to the warehouses and unloaded by fork truck as the tractor picks up a string of empty trailers.

Similarly, fork trucks, in combination with the usual winches and booms, have greatly facilitated and quickened up the time-consuming task of loading ocean liners at a New York pier. The turn-round time of the ship has been cut and cargo-handling done with a minimum of breakage. The stevedore receives the materials at the trucking docks and at once places them on to special pallets which can take loading slings. Fork-lift trucks of 6,000 lb. capacity move the loaded pallets to pier storage or directly to the ship side. When the loaded pallets are so moved, slings fitted with two wooden bars that slip into the open edges of the pallet are placed in position by longshoremen. The load is then lifted and lowered into the hold. Pallets are there unloaded and returned at regular intervals to the dock for re-use. The ability of the fork-truck to carry double pallet loads and to stack to three or four pallet heights has more than doubled the capacity of the shipping warehouse.

Underwater Rubber Coatings

Improved methods of applying synthetic rubber coatings to ships' propeller shafts as protection against seawater damage are reducing maintenance and repair costs. Such coverings have preserved exposed shafting for as long as twenty months after application. Dry-dock shaft covering of this type involves techniques which can be applied without delaying the ship's docking periods excessively or running up costs too high. Rubber coatings have been developed which, though not so tough and adherent as vulcanized natural sheet rubber, offer better protection when compared with most paint systems. These coatings include brush-on neoprenes, which have, however, certain peculiarities difficult to overcome. More recently a technique has been developed for applying previously vulcanized sheet rubber to steel shafts by means of a good neoprene cement. The sheet must be applied in sections not more than $\frac{1}{16}$ in. thick. The adhesion is of the same order as that expected from unvulcanized sheet rubber.

Harbour Retaining Caissons

Pre-cast concrete caissons 29 ft. dia. and hollow are being used to form a harbour retaining wall in France. The caissons are sunk into the soft bottom, and a heavy concrete decking is cast *in situ* at the top. The space between each caisson is filled by a segmental concrete pile, and reinforcing bars in the holes provided in the caisson walls tie in with the decking. This construction has been chosen in preference to a solid wall, as in the event of any sinking only a section of the caissons would be effected, and adjustments could be made without affecting the rest of the structure. Steel guides are used in the alignment and placing of the cylinders, which are sunk by weights on platforms at the top.

The synthetic fibre, terylene, is being used for two-ropes in place of sisal, Six-inch circumference terylene rope has been found to have twenty-three times the lift of equivalent sisal rope, and its strength and endurance are said to compare favourably, in spite of a higher first cost.

Alloy Deck Plates

Tenders are having their carbon steel deck plates replaced by a corrosion-resistant, high-strength, low alloy steel containing nickel and other alloying elements. This is much better than carbon steel for resisting corrosion from the water and the atmosphere. It does not form a rust that flakes off, exposing the new surface to further corrosion, but forms a thin, tightly adherent surface layer which shields the metal below from further attack. It also has a 50 per cent. higher yield strength than carbon steel, and can therefore be used in thinner sections to reduce dead weight. It can be readily welded and formed.

New Quay at Pateniemi, Finland

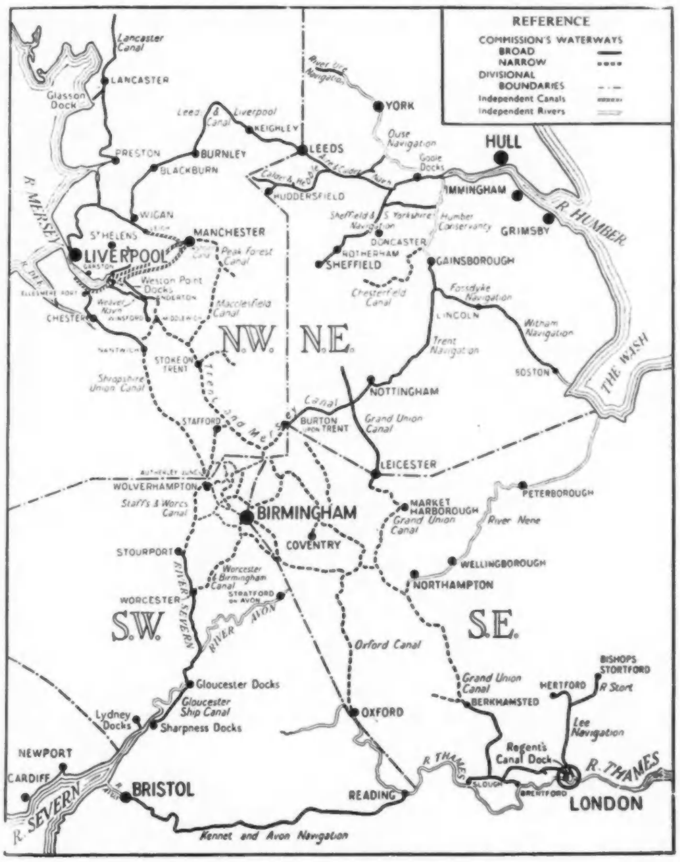
Construction of a new jetty at Pateniemi which was commenced 18 months ago, is making good progress and the jetty, which is 500 metres long, was recently taken into use, enabling six medium size vessels to load at the same time. When further extensions are completed by 1957, four additional ships will be able to berth alongside where the depth of water ranges from 23 feet to 20 feet. This depth will enable a large icebreaker to keep a channel open when ice forms and will eliminate delays in moving lighters through the ice to ships. The new jetty will also enable loading from lighters in the Roads to be eliminated and rough weather delays to be avoided. Other improvements to increase the speed of loading include a yard for wood cargoes and special handling equipment such as fork lift trucks. Two steel lighters will be used as a mole to protect ships berthed on the outer side of the quay.

Inland Waterways Development Scheme

Improvements by British Transport Commission

The British Transport Commission recently published details of their plan for the development of the principal inland waterways of the United Kingdom. The plan covers over 325 miles of canals, involves the expenditure of £5,500,000 and extends over a five year period. The waterways concerned, proposed expenditure and tonnage carried in 1954 are as follows :—

	Length (Miles)	1954 *Tonnage* (Tons)	*Proposed Expenditure* £
Aire & Calder Navigation	62½	2,581,150	765,000
Sheffield & South Yorkshire Navigation	43¼	941,250	614,000
River Trent	68¾	715,390	595,000
River Weaver	20	626,110	387,000
Grand Union Canal (below Berkhamsted)	57¼	736,150	1,396,000
River Lee (below Enfield Lock) ...	14¼	2,096,280	852,000
River Severn (including Gloucester/Berkeley Canal)	59¼	497,790	891,000
Total ...	325¼	8,194,120	5,500,000



Although these waterways represents only 15 per cent. of the total mileage vested in the British Transport Commission, they carry two-thirds of the total traffic of about 12 million tons a year. Each one links an important industrial area to a major estuary or port and can be used by large barges and coastal craft, ranging from 60 tons capacity on the Grand Union Canal to 400 tons on parts of the Weaver and Severn.

The major part of the £5½m. is to be spent on bank protection and navigation works. When the waterways were first constructed, little or no bank protection was provided, and the effect of the wash created by modern powered craft upon the original banks and stone walls has been disastrous, so that over long distances, steel or concrete piling is now a necessity. In addition to this work, navigational channels are to be improved by dredging, widening, re-alignment and the removal of rock outcrops or other obstructions, and weirs and sluices are to be repaired or reconstructed. It is proposed to spend £3,345,000 on these works.

Locks are to be widened to remove " bottlenecks ". This will eliminate delay and enable craft of maximum size to reach points where traffic is available, and will cost £1,105,000.

The sum of £636,000 is to be used to provide additional dredging craft and plant.

The remaining £414,000 is to be spent on the modernisation of certain premises, and new or improved facilities, such as dry docks, covered slipways or cranes, will be provided at certain workshops and repair yards.

A great deal of the proposed work is essential maintenance of the waterways system, but where capital expenditure is involved, consideration will be given to the national investment policy, and work will be put in hand as economic conditions permit.

Although the plan is confined to the development of the waterways themselves, and does not include projects for the improvement or extension of the Commission's waterway traffic interests such as carrying craft, warehouses and similar installations, these facilities are being kept under review.

Schemes totalling £500,000 have already been announced for the Trent Navigation and the Aire & Calder Navigation, and many other smaller projects have been authorised. Steps are also being taken to improve the maintenance of a further 994 miles of waterways which the Commission consider to be worth retaining either by reason of the tonnage of traffic upon them, or because they form a through route, and further narrow boats are being brought into use.

The Commission, who own only about one-third of the total canal craft, are hoping that these new improvement plans will bring about an increasing use of the waterways by canal carriers and traders.

Geelong Grain Terminal

Details of Handling Facilities

The article on the Port of Geelong which appeared in the December 1955 issue of this Journal made brief reference to the Bulk Wheat Terminal at that Port. Further details of the facilities for wheat storage and handling are now given, and in this connection it will be of interest to repeat the wheat export figures which were published in the article referred to above.

Year	*Tons*
1950	559,821
1951	613,505
1952	280,748
1953	258,344
1954	397,301

Delivery of Wheat into the Terminal

The wheat from 200 receiving elevators located in the wheat producing areas of the State of Victoria is conveyed to the Geelong Terminal in general utility flat-bottom type railway trucks. A removable tarpaulin placed in position on the rail trucks at the loading stations protects the wheat from weather damage during transit. Frequently 300 rail trucks, each holding over 20 tons of wheat, are discharged in one day at the main Terminal structure which has three intake elevators each of 400 tons per hour capacity.

Doors of the rail trucks are opened when each rail truck is positioned over a discharge hopper located below the rail track in the discharge section. Approximately two-thirds of the wheat gravitates from the rail truck to the receiving hopper immediately the rail truck doors are opened. The remaining one-third of the wheat in the rail truck is discharged by a machine which removes the tarpaulin from one side of the rail truck, inserts two blades into the truck and pushes the remaining wheat out of the truck so that it, too, gravitates into the hopper below the rail track. Four 20 ton rail trucks can be discharged every three minutes.

Each rail-truck load of wheat retains its separate identity until it is elevated to the top of the Working House section of the Terminal

Geelong Grain Terminal—*continued*

Fig. 1

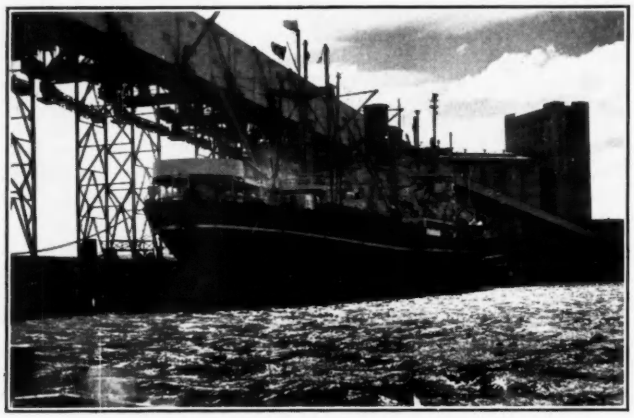


Fig. 2

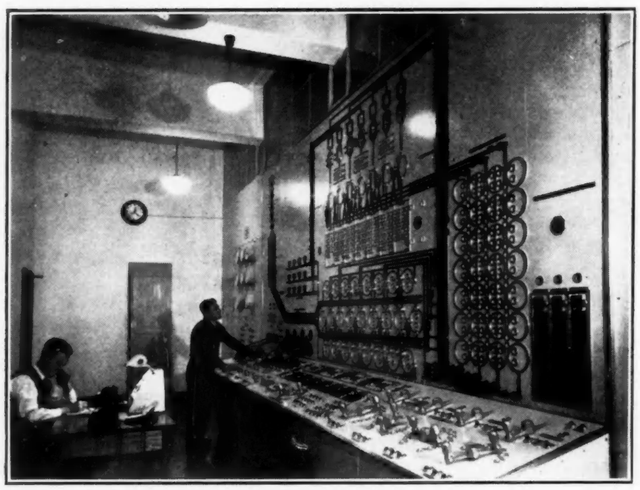


Fig. 3

200 ft. above ground level, where it is weighed and classified. Thereafter the wheat is conveyed on belts to the bin holding wheat of the same classification.

The Main Terminal

The Main Terminal has 56 large circular and 36 interspace concrete bins and two annex storages (Fig. 1). Each of the annexes holds 9 million bushels. The annex buildings are 900 feet long and 300 feet wide. The roof spans the full 300 feet width and the centre of the arch of the roof is 85 feet above ground level. The side walls, which are of concrete and on which the roof arch rests, are approximately 10 feet high. A conveyor system capable of carrying 400 tons per hour is located below the centre of the roof arch and that is used to place the wheat in the annex.

When the annex is full of wheat the measurements of the wheat pile are 900 feet long, 300 feet wide, 10 feet high at the side walls and 75 feet high at the centre of the pile just under the top conveyor and the storage capacity when so filled approximates 9 million bushels of what in one huge pile.

The floors of the annex are concrete and an 8 ft. square tunnel is located below ground level in the centre of the building. A conveyor system located in the tunnel provides a means whereby the wheat in the annex buildings can be returned to the Main Terminal at the rate of 400 tons per hour. The major portion of that huge pile of wheat gravitates on to the tunnel conveyor through valves which are spaced every 10 feet apart along the top of the tunnel. That section of the wheat in the pile which will not gravitate on to the tunnel conveyor is moved thereto by an open-faced auger machine so fitted that it spans the 150 feet width of the floor on each side of the tunnel.

The Shipping Section

The Main Terminal structure has 4 elevators which feed wheat into the Shipping Section. Each such elevator has a capacity of 400 tons per hour and 4 conveyor belts run from the shipping bins in the Main Terminal through the Shipping Gallery which connects the Main Terminal with the Board's Pier at which there is room to berth two vessels which desire to take on wheat cargo (Fig. 2). Each conveyor has a capacity of 400 tons per hour. Therefore, wheat can be conveyed to one or two ships at the overall rate of 1,600 tons per hour.

When holds of vessels taking on wheat have been filled by gravity flow to about 80 per cent. of their capacity, wheat trimming machines are lowered into the holds to complete the stowage of the wheat necessary to fill the hold to capacity. These machines have a throwing action and stow at the rate of 200 tons per hour. The use of those machines has eliminated the necessity for sending men down into the ships' hold to stow the wheat manually in such locations.

The Main Terminal and its annexes have an overall storage capacity slightly in excess of 22 million bushels. The whole terminal operation is controlled from a specially designed air-conditioned Control Room (Fig. 3).

A dust extraction system operates throughout the Terminal and this permits of the wheat dust that arises from the wheat being sucked into a building located a short distance from the Terminal where it is placed in corn sacks. As such dust comes mainly from the skin of the wheat, its protein content is high and it is subsequently disposed of for stock feed.

Queensland Harbours Report

Heavy Dredging Programme at Brisbane

The report of the Department of Harbours and Marine, Queensland, for the year ended June 30th, 1955, states that 1,128 vessels with a net tonnage of 3,541,659 used the port. Receipts from Harbour Dues were £687,452 as compared with £602,832 for the previous year.

The watershed of the Brisbane River was subjected to frequent heavy rain but due to flood mitigation works commenced in 1935 and to the widening and deepening of river cuttings the flood height was 11 ft. 6 in. at the Port Office gauge compared with 14 ft. 7½ in. in 1931 when flood conditions were similar. The effect of the abnormal discharge of upland waters has been to increase greatly the quantity of silt carried down from cultivation on the banks of the upper reaches of the river. The silt concentration rose from half a grain to the gallon to 32 grains to the gallon, and although the suction dredgers were removing 15,000 tons of material per day, there was evidence from frequent soundings that, during one month, the Hamilton Reach decreased in depth. At the time of the report (the end of October, 1955) the suction dredgers had the river maintenance well in hand.

The dredging programme designed to provide a minimum of 31 ft. L.W.S.T. from the Pile Light to Hamilton was begun by the bucket dredger *Groper*, which carried out trials on the heavy, sticky clay in the bed of Quarries Reach. One-sixth of the reach has been dredged to the depth required.

A considerable amount of work has been done in maintaining berths at the request of wharf-owners, who bear the cost. Wharf berths are now deepened by suction dredger and clam dredger;

Queensland Harbours Report—continued

both are effective. The clam dredger at the time of construction was fitted with the largest Priestman grab crane then manufactured. This machine can remove 3 cu. yds. of mud at each bucketful and takes but 45 seconds for each bite. At present one suction dredger is employed constantly on berth maintenance and removes per day from 4,000 to 6,000 tons of mud, while the clam dredger clears mud, debris, broken cargo, &c., from along the fender piles to a distance of 33 ft. out from the piles.

A pleasing feature is the satisfaction expressed by wharf-owners in connection with the plant provided and, in particular, with the clam dredger. It is intended to augment the plant further by replacing the steam crane on the grab dredger *Mourilyan* with a Priestman diesel-operated machine.

The bucket dredger *Groper*, which arrived from Scotland in November, 1954, began work at Bulimba Point before going to Quarries Reach. In June, 1955, the dredger was sent to Mackay to deepen the tanker berth at that port. The very heavy silting of the Brisbane River curtailed the deepening programme and bucket dredgers have been used for maintenance works in addition to the suction dredgers.

The Brisbane Stevedoring & Wool Dumping Company Pty., Ltd., opened an additional 700 ft. of modern wharf, complete with wharf shed, on May 6, 1955. This berth provides an extension to the existing 1,100 ft. owned by the company and is built of timber with a concrete deck and a galvanised iron wharf shed.

Personalia

Mr. B. J. Roberts, C.B.E., was appointed Chairman of the National Harbours Board, Canada, in December, 1954, having served as a member of the Board since its inception in 1936. The Board is constituted under special statute of the Parliament of Canada as a Crown corporation and administers the harbours of Halifax, N.S., Saint John, N.B., Chicoutimi, P.Q., Quebec, P.Q., Three Rivers, P.Q., Montreal, P.Q., Churchill, Man., and Vancouver, B.C., also the Jacques Cartier Bridge, Montreal, and grain elevators at Port Colborne and Prescott in Ontario. The capital assets of the corporation, at cost, amount to about $250,000,000. The annual cargo tonnage is about 41,000,000, and the operating revenues $20,250,000.

Mr. Roberts was born in Newfoundland in 1892. He graduated with a B.A. degree from the University of Toronto and was employed by several mercantile firms and also financial and daily newspapers in Toronto. In 1917 he entered the Department of Finance and shortly thereafter was appointed private secretary to the Minister of Finance, then Sir Thomas White. He was Assistant Deputy Minister of Finance when he was chosen for the National Harbours Board on its formation in 1936. Mr. Roberts has been connected with a number of public enquiries, having acted as secretary of a Customs Tariff enquiry in 1920, as financial adviser to the Royal Commission on Railways and Transportation in 1931, and secretary of the Royal Commission on Banking and Currency in 1933. He served as a member of the Canadian Farm Loan Board for a period and presently is Vice-Chairman of the Merchant Seamen Compensation Board. He also held the position of financial adviser to the British Commonwealth Air Training Plan for a time during the last war. He has been a director of the American Association of Port Authorities and in November last, at a meeting held in Los Angeles, Calif., was elected the first president of the newly-created International Association of Ports and Harbours.

Mr. C. H. Nicholson, M.I.Mech.E., M.I.E.E., F.R.S.A., Mechanical and Electrical Engineer (General Duties), British Transport Commission, Docks, relinquished his post last December.

Mr. Nicholson was trained at the Hull College of Technology and, after a short period with the Hull Electricity Supply Undertaking, joined the Hull and Barnsley Railway Company. Upon amalgamation he was appointed Assistant Mechanical Engineer, Hull Docks, and later became Chief Docks Machinery Engineer to the London and North Eastern Railway Company until nationalisation when he was appointed Mechanical and Electrical Engineer, Humber Ports. He held this post until his appointment as Mechanical and Electrical Engineer (General Duties), British Transport Commission, Docks.

Mr. Nicholson was a member of the British Standards Institution Committees in connection with goods handling appliances, cranes, etc., and also Chairman of the B.T.C. Docks, Mechanical and Electrical Engineers' Technical Committee.

Obituary

Mr. F. W. Tipton

We regret to learn of the death in London of Mr. Fred William Tipton, managing director of the Thames Steam Tug and Lighterage Company Ltd. Mr. Tipton, who was 69 years of age, spent his early years in local government work, and was then for a time on the secretarial staff of the Association of Master Lightermen and Barge Owners. About 30 years ago he joined the Thames Steam Tug and Lighterage Company. In 1939 he was elected to the board, and became managing director in the following year. For about the past two years he had been chairman of the Lee Conservancy Board.

Mr. G. H. James

It is also with regret we announce the death at his home at Lyndhurst, of Mr. George Harold James, former general manager of the James Contracting and Shipping Company, Ltd., Southampton. He was 67. Mr. James was born at Birkenhead and served a five-year apprenticeship in marine engineering in Liverpool. He then joined the White Star Line as a junior engineer and served in the old Britannic. He subsequently joined the firm which his brother had just founded at Southampton, and specialised in the dredging side of the business. In the late 1920's, when he was in charge of all the dredging work in connection with the construction of the Southampton New Docks, he was appointed general manager of the company; and about 12 years ago he was elected to the board. He retired from business in August, 1954.

Mr. S. R. Hobday

Mr. Stephen Reginald Hobday, whose death was announced on February 6th, was prior to his retirement in 1948 Clerk of the Board and General Manager of the Lee Conservancy Catchment Board. For many years Mr. Hobday took a prominent part in the affairs of the Waterworks Industry. He was a member of the Central Canal Committee, during the last war, and a former Chairman of the National Joint Council for the Inland Waterways Industry. As a member of the Central Advisory Water Committee he took a keen interest in the prevention of pollution of rivers and was Chairman of a sub-committee of that body whose recommendations led to the passing of the Rivers (Prevention of Pollution) Act, 1951.

APPOINTMENTS VACANT

CIVIL ENGINEERING and Structural Steelwork designers required by Westminster Consulting Engineers. Suitable applicants would be given the opportunity of site experience abroad after completion of twelve months satisfactory service. Salary according to experience. Five day week. Pension scheme. Luncheon vouchers. Apply stating age and experience to Box No. 179, "The Dock and Harbour Authority," 19 Harcourt Street, London, W.1.

DUBLIN PORT AND DOCKS BOARD

VACANCY FOR ASSISTANT HARBOUR MASTER

Salary scale: £851—£1,059. Car allowance. Age-limits: 28—35 with extensions in certain cases. Essential qualifications include Extra Master's certificate or a Master's Certificate (Foreign-going). Application forms and particulars from the Secretary, Local Appointments Commission, 45 Upper O'Connell Street, Dublin.
Latest time for receiving completed application forms: 5.0 p.m. on 16th March, 1956.

MELBOURNE HARBOUR TRUST

VACANCY FOR ASSISTANT INSPECTOR OF MACHINERY

Salary £A.1,600 including Cost of Living Adjustments. Minimum Qualification: 1st Class Board of Trade Marine Engineers Certificate with Diesel Endorsement.
Applications close with Secretary, Melbourne Harbour Trust Commissioners, 29 Market Street, Melbourne, Victoria, Australia on Friday, 2nd March 1956. Conditions of appointment may be obtained from the office of the Agent General for Victoria, Victoria House, Melbourne Place, Strand, London, W.C.2.

VACANCY FOR DIVISIONAL ENGINEER
NORTH WESTERN DIVISION

British Transport Waterways invite applications for the position of Divisional Engineer, North Western Division (office at Liverpool); salary range £1,800—£2,200 per annum, superannuation scheme and certain privilege railway facilities.
Applicants must be Corporate Members of the Institution of Civil Engineers with wide experience in design, construction and maintenance of inland waterway and marine works. The person appointed will be responsible for civil, mechanical and electrical matters of the Division; sound knowledge of general engineering practice required and ability to organise and assume efficient control of engineering staff.
Applications addressed to the Staff and Establishment Officer, British Transport Waterways, 22 Dorset Square, London, N.W.1, to arrive not later than 29th February, 1956.

NIGERIAN PORTS AUTHORITY

The Nigerian Ports Authority have vacancies for two PORT ENGINEERS for duty at the Ports operated by the Authority. The Authority is a recently created Public Corporation and offers good prospects.
Candidates should be not less than 30 years of age, possess a recognised engineering qualification and preferably be experienced in the construction and maintenance of Dock and Harbour works, and associated mechanical equipment. The post will give ample opportunity to acquire further experience of administration and control under the direction of the Chief Engineer. The Authority is responsible for two major ports with deep water facilities for thirty vessels, for inland waterways, coast lighting, etc. At the moment major development schemes are in preparation and progress, and these will continue for the next five years.
Th commencing salary will be at the consolidated rate of £2,000 per annum, which figure includes an element for Overseas Pay. Appointment will be for one tour in the first instance, thereafter, subject to satisfactory service, employment will be offered on a permanent basis and officers will be eligible for membership of the Pension Scheme which the Authority is about to introduce. This will be entirely non-contributory. It may be possible to preserve existing pension rights.
The maximum tour is 15 months but normally 10 to 12 months. Free first-class return passages for officer, wife and two children. When children are maintained outside Nigeria an allowance at the rate of £75 per annum for each of two children is payable in addition. Quarters furnished to a comfortable standard are provided at a rental of 8.1/3% of salary (maximum £150 a year). Outfit allowance £60. Leave on full salary at the rate of 7 days for each month's service. Free medical services. Loans for car purchase are made in approved cases and eligibility for certain car and mileage allowances.
Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2B/40486/DU

TENDERS

DUBLIN PORT AND DOCKS BOARD

NEW GRAVING DOCK
ELECTRICAL INSTALLATION

The latest date for receipts of tenders has been extended to 24th February, 1956. Full particulars can be obtained from Mr. Nicholas O'Dwyer, B.E., M.I.C.E., Consulting Engineer, 6 Burlington Road, Dublin.

Port and Docks Office,
DUBLIN.

J. P. Murphy,
Secretary.

WANTED

URGENTLY REQUIRED Two Shallow Draft, sectional preferred, bottom Dump Barges capacity 60 to 80 cubic yards. Self propelled or for towing. Full details Box 180, "The Dock and Harbour Authority," 19 Harcourt Street, London, W.1.

FOR SALE

ONE secondhand 15" x 20" Outside Cylinder Saddle Tank Locomotive 0-4-0 type for 4'—8½" gauge. Boiler suitable for a pressure of 160 lbs. per sq. inch, steel firebox and tubes, Ramsbottom Safety Valves. Stephensons link type motion, steam and hand brakes, hand sanding on all wheels. The whole of the locomotive has just been thoroughly overhauled and repaired by the original Builders including the fitting of a new Inner Firebox and new Steel Tubes, and tested and run in steam to prove all in first class working order. PALMER MANN & COMPANY LIMITED, Sifta Salt Works, SANDBACH, Cheshire.

Sealed bids for the purchase of floating equipment offered for sale by Panama Canal Company will be received in the office of Procurement Officer, 21 West Street, New York 6, N.Y., until 10.30 a.m., E.S.T., April 6th, 1956, and at that time publicly opened. This equipment, covered by Invitation No. 235, consists of hydraulic grader, air compressor barge, relay pump barge, and one 1200 ton silt barge. If complete brochure and bid forms are desired, contact Procurement Officer, Panama Canal Company, 21 West Street, New York 6, N.Y. BO 9-5380.